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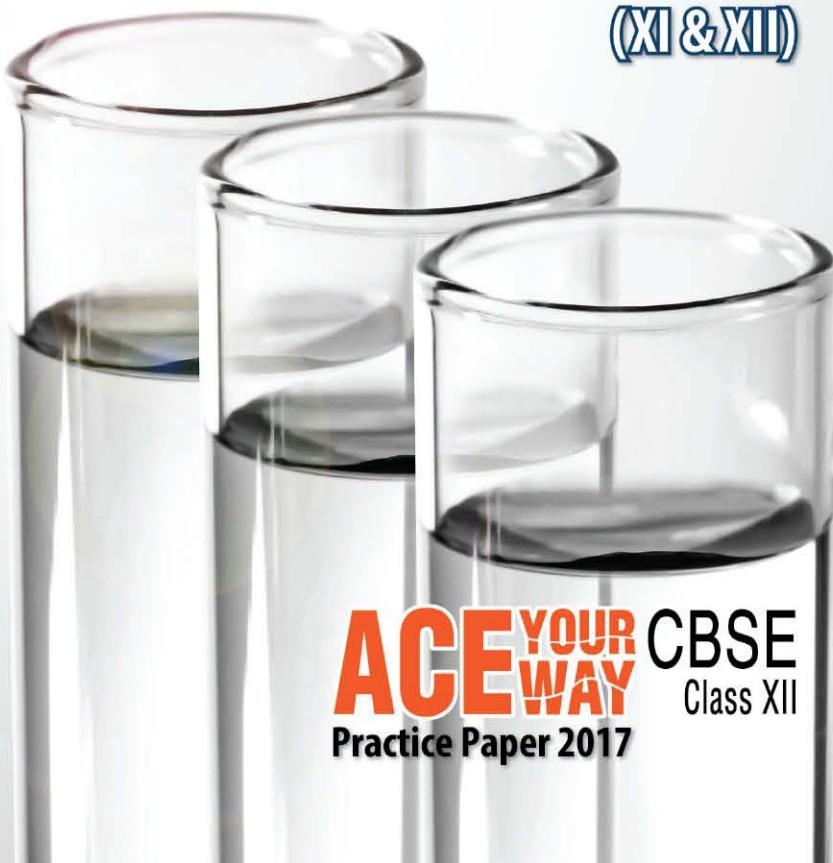
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# today

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# CHEMISTRY MUSING

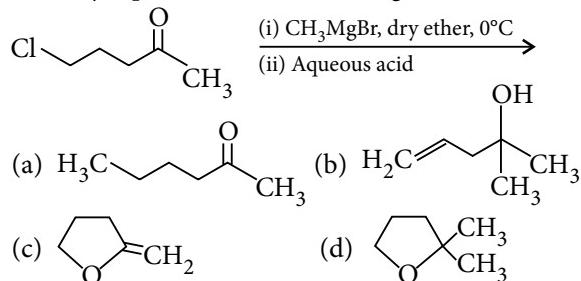
## PROBLEM SET 44

**C**hemistry Musing was started from August '13 issue of Chemistry Today. The aim of Chemistry Musing is to augment the chances of bright students preparing for JEE (Main and Advanced) / NEET / AIIMS / PMTs with additional study material. In every issue of Chemistry Today, 10 challenging problems are proposed in various topics of JEE (Main and Advanced) / NEET. The detailed solutions of these problems will be published in next issue of Chemistry Today. The readers who have solved five or more problems may send their solutions. The names of those who send atleast five correct solutions will be published in the next issue. We hope that our readers will enrich their problem solving skills through "Chemistry Musing" and stand in better stead while facing the competitive exams.

### JEE MAIN/NEET

1. The iodine molecule dissociates into atoms after absorbing light of  $4500 \text{ \AA}$  if one quantum of radiation is absorbed by each molecule. The kinetic energy of iodine atoms is  
(Bond energy of  $I_2 = 240 \text{ kJ mol}^{-1}$ )  
(a)  $21.6 \times 10^{-10} \text{ J}$       (b)  $21.6 \times 10^{-20} \text{ J}$   
(c)  $2.16 \times 10^{-10} \text{ J}$       (d)  $2.16 \times 10^{-20} \text{ J}$

2. The major product in the following reaction is



3. A colourless inorganic salt (A) decomposes completely at about  $523 \text{ K}$  to give only two products (B) and (C) leaving no residue. The product (B) is a neutral gas while the product (C) is liquid at room temperature and is neutral to litmus. White phosphorus burns in excess of (B) to produce a strong dehydrating agent,  $P_4O_{10}$ . The compounds (A), (B) and (C) are respectively  
(a)  $\text{NH}_4\text{NO}_2, \text{N}_2, \text{H}_2\text{O}$  (b)  $\text{NH}_4\text{NO}_3, \text{N}_2\text{O}, \text{H}_2\text{O}$   
(c)  $\text{NH}_4\text{Cl}, \text{NH}_3, \text{NCl}$  (d)  $\text{NaNO}_3, \text{O}_2, \text{NaNO}_2$

- 4.

In the above reaction sequence, II is

- (a)  $\beta$ -alanine      (b)  $\alpha$ -alanine  
(c) ethylenediamine      (d)  $\gamma$ -aminobutyric acid.

5. An aqueous solution of a substance gives a white ppt. on treatment with dilute hydrochloric acid which dissolves on heating. When hydrogen sulphide is passed through the hot acidic solution, a black ppt. is obtained. The substance is a  
(a)  $\text{Hg}_2^{2+}$  salt      (b)  $\text{Cu}^{2+}$  salt  
(c)  $\text{Ag}^+$  salt      (d)  $\text{Pb}^{2+}$  salt.

### JEE ADVANCED

6. An element crystallises in fcc lattice having edge length  $400 \text{ pm}$ . The maximum diameter which can be placed in interstitial sites without disturbing the structure is  
(a)  $1.171 \text{ pm}$       (b)  $11.71 \text{ pm}$   
(c)  $117.1 \text{ pm}$       (d)  $0.117 \text{ pm}$

### COMPREHENSION

The process of settling of colloidal particles is known as coagulation of the sol. The particles in any colloidal sol carry a particular charge and can be coagulated by adding suitable electrolytes. Generally, it is observed that, greater the valency of the flocculating ion added, greater is its power to coagulate. Lyophobic sols are generally less stable but can be protected by lyophilic colloids, called protective colloids. Their protective powers are usually expressed in terms of gold number.

7.  $\text{SnO}_2$  is shaken with a small amount of  $\text{NaOH}$  solution to form a colloidal sol of sodium stannate. The sol thus obtained can be coagulated most easily by  
(a)  $\text{Na}_3\text{PO}_4$       (b)  $\text{AlCl}_3$   
(c)  $\text{K}_4[\text{Fe}(\text{CN})_6]$       (d)  $\text{HCl}$
8.  $50 \text{ mL}$  of standard gold sol requires  $0.1 \text{ g}$  of potato starch for its protection from coagulation. The gold number of potato starch is  
(a) 5      (b) 10      (c) 20      (d) 25

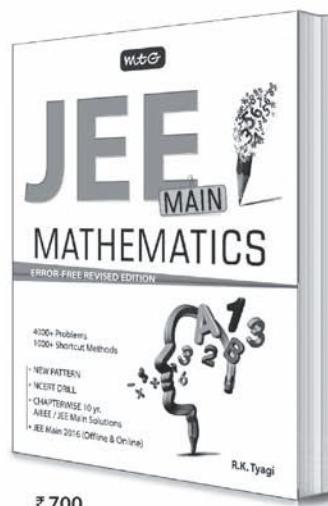
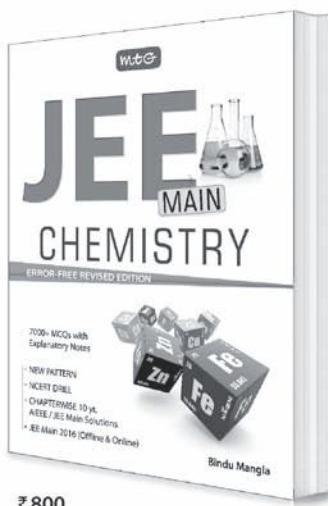
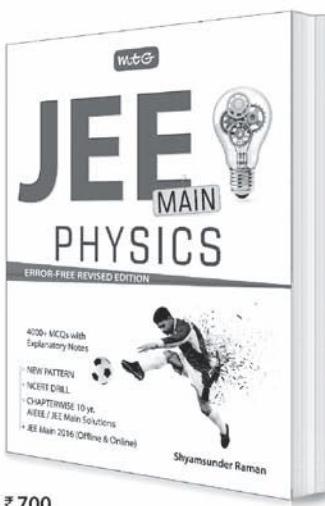
### INTEGER VALUE

9. The vapour pressure of pure benzene at a certain temperature is  $640 \text{ mm Hg}$ . A non-volatile, non-electrolyte solid weighing  $2.175 \text{ g}$  is added to  $39 \text{ g}$  of benzene. The vapour pressure of the solution is  $600 \text{ mm Hg}$ . The molecular weight of the solid substance is  $60 + 1.05x$ . The value of  $x$  is
10. Consider the following list of reagents : acidified  $\text{K}_2\text{Cr}_2\text{O}_7$ , alkaline  $\text{KMnO}_4$ ,  $\text{CuSO}_4$ ,  $\text{H}_2\text{O}_2$ ,  $\text{Cl}_2$ ,  $\text{O}_3$ ,  $\text{FeCl}_3$ ,  $\text{HNO}_3$  and  $\text{Na}_2\text{S}_2\text{O}_3$   
The total number of reagents that can oxidise aqueous iodide to iodine is



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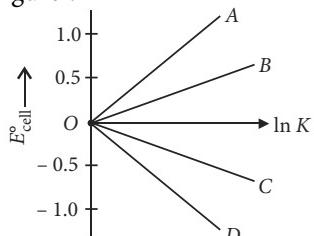
# PRACTICE PAPER **JEE MAIN**

2017

## **Exam Dates**

OFFLINE : 2<sup>nd</sup> April

ONLINE : 8<sup>th</sup> & 9<sup>th</sup> April



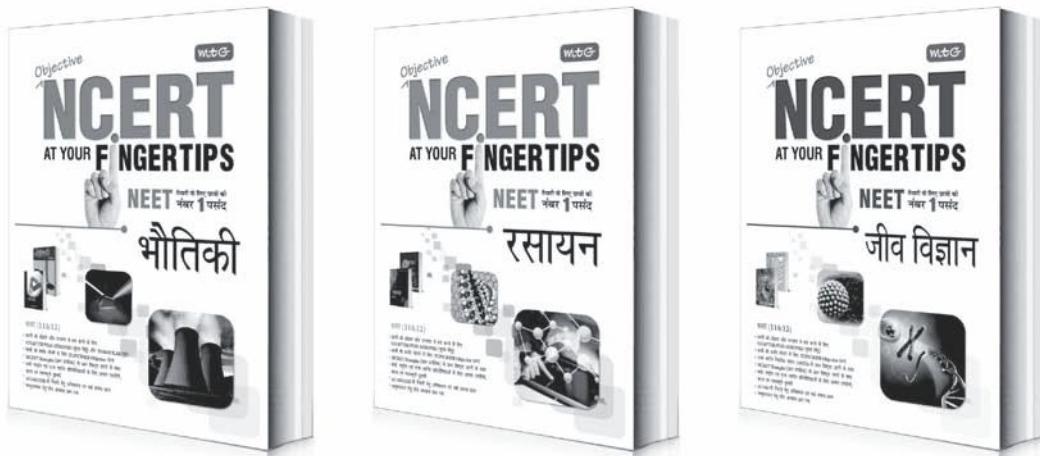
- 11.**   $\xrightarrow{\text{NaOH}}$  [Intermediate]  $\xrightarrow[\text{(ii) } \text{D}^+]{\text{(i) } \text{CO}_2} P$

Here  $P$  is

Here  $P$  is

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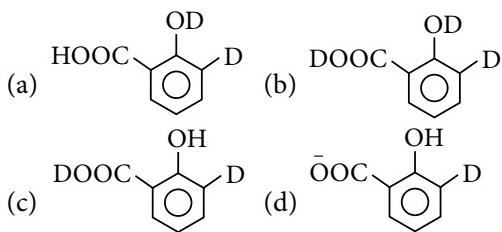
## ये तीनों पुस्तकें ही क्यों पढ़नी जरूरी हैं?

- प्रश्नों को शीघ्रता और सरलता से हल करने के लिए CHAPTERWISE SYNOPSIS (मुख्य बिंदु)
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12.  $K_{sp}$  of  $Mg(OH)_2$  is  $1 \times 10^{-12}$ , 0.01 M  $MgCl_2$  will be precipitating at the limiting pH  
 (a) 8      (b) 9      (c) 10      (d) 12

13. A white crystalline solid (A) on boiling with caustic soda solution gave a gas (B) which when passed through an alkaline solution of potassium mercuric iodide gave a brown ppt. The substance (A) on heating gave a gas (C) which rekindled a glowing splinter but did not give brown fumes with nitric oxide. The gases (B), (C) and the substance (A) respectively are  
 (a)  $H_2S$ ,  $NO_2$ ,  $NaCl$     (b)  $NH_3$ ,  $N_2O$ ,  $NH_4NO_3$   
 (c)  $HCl$ ,  $NO$ ,  $NH_4Cl$     (d)  $CO_2$ ,  $SO_2$ ,  $Na_2SO_3$

14. One mole of magnesium in the vapour state absorbed 1200 kJ mol<sup>-1</sup> of energy. If the first and second ionisation energies of Mg are 750 and 1450 kJ mol<sup>-1</sup> respectively, the final composition of the mixture is  
 (a) 31%  $Mg^+$  + 69%  $Mg^{2+}$   
 (b) 69%  $Mg^+$  + 31%  $Mg^{2+}$   
 (c) 86%  $Mg^+$  + 14%  $Mg^{2+}$   
 (d) 14%  $Mg^+$  + 86%  $Mg^{2+}$

15. If the molecular weight of  $Na_2S_2O_3$  and  $I_2$  are  $M_1$  and  $M_2$  respectively then what will be the equivalent weights of  $Na_2S_2O_3$  and  $I_2$  in the following reaction?  
 $2S_2O_3^{2-} + I_2 \longrightarrow S_4O_6^{2-} + 2I^-$   
 (a)  $M_1, M_2$       (b)  $M_1, M_2/2$   
 (c)  $2M_1, M_2$       (d)  $M_1, 2M_2$

16. The ionisation energy of hydrogen atom (in the ground state) is  $x$  kJ. The energy required for an electron to jump from 2<sup>nd</sup> orbit to the 3<sup>rd</sup> orbit will be  
 (a)  $x/6$     (b)  $5x$     (c)  $7.2x$     (d)  $5x/36$

17. 1 mole of a non ideal gas undergoes a change of state (2.0 atm, 3.0 L, 95 K)  $\longrightarrow$  (4.0 atm, 5.0 L, 245 K) with a change in internal energy,  $\Delta U = 30.0$  L atm. The change in enthalpy ( $\Delta H$ ) of the process (in L atm) is  
 (a) 40.0  
 (b) 42.3  
 (c) 44.0  
 (d) not defined because the pressure is not constant.

18. *n*-Butylamine(I), diethylamine(II) and *N,N*-dimethylethylamine(III) have the same molar mass. The increasing order of their boiling points is

- (a) III < II < I      (b) I < II < III  
 (c) II < III < I      (d) II < I < III

19. An organic compound (A) reacts with methyl magnesium iodide to form an addition product which on hydrolysis forms the compound (B). Compound (B) gives blue colour salt in Victor Meyer's test. The compound (A) and (B) are respectively  
 (a) acetaldehyde, tertiary butyl alcohol  
 (b) acetaldehyde, ethyl alcohol  
 (c) acetaldehyde, isopropyl alcohol  
 (d) acetone, isopropyl alcohol.

20. Aluminium chloride exists as dimer,  $Al_2Cl_6$  in solid state as well as in solution of non-polar solvents such as benzene. When dissolved in water, it gives  
 (a)  $[Al(OH)_6]^{3-} + HCl$     (b)  $[Al(H_2O)_6]^{3+} + Cl^-$   
 (c)  $Al^{3+} + Cl^-$       (d)  $Al_2O_3 + HCl$

21. The time required for 10% completion of a first order reaction at 298 K is equal to that required for its 25% completion at 308 K. If the pre-exponential factor for the reaction is  $3.56 \times 10^9$  s<sup>-1</sup>, calculate its rate constant at 318 K.  
 (a)  $0.92 \times 10^{-4}$  sec<sup>-1</sup>    (b)  $9.22 \times 10^{-4}$  sec<sup>-1</sup>  
 (c)  $92.2 \times 10^{-4}$  sec<sup>-1</sup>    (d)  $92 \times 10^{-4}$  sec<sup>-1</sup>

22. Match the lists I and II and pick the correct matching from the codes given below.

**List I**

- (A)  $[Ag(CN)_2]^-$   
 (B)  $[Cu(CN)_4]^{3-}$   
 (C)  $[Cu(CN)_6]^{4-}$   
 (D)  $[Cu(NH_3)_4]^{2+}$   
 (E)  $[Fe(CN)_6]^{4-}$

**List II**

1. Square planar and 1.73 B.M.  
 2. Linear and zero  
 3. Octahedral and zero  
 4. Tetrahedral and zero  
 5. Octahedral and 1.73 B.M.  
 (a) A - 2, B - 4, C - 5, D - 1, E - 3  
 (b) A - 5, B - 4, C - 1, D - 3, E - 2  
 (c) A - 1, B - 3, C - 4, D - 2, E - 5  
 (d) A - 4, B - 5, C - 2, D - 1, E - 3.

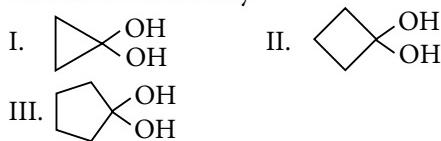
23. 10 g atoms of an  $\alpha$ -active radioactive isotope are disintegrating in a sealed container. In one hour, helium gas collected at STP is 11.2 cm<sup>3</sup>. The half-life of the radioactive isotope is  
 (a) 138.6 hr      (b) 1386 hr  
 (c) 13860 hr      (d) 138600 hr

- 24.** Match the column I with column II and mark the appropriate choice.

<b>Column I</b>	<b>Column II</b>
A. Self reduction	P. Lead
B. Carbon reduction	Q. Nickel
C. Thermal decomposition of its carbonyl	R. Copper
D. Decomposition of its iodide	S. Titanium
<b>A      B      C      D</b>	
(a) P, R      P, S      Q      S	
(b) P, S      P, R      Q      S	
(c) P, R      P, R      Q      S	
(d) P, Q      P, R      Q      S	

- 25.** Work done in expansion of an ideal gas from 4 L to 6 L against a constant external pressure of 2.5 atm was used to heat up 1 mole of water at 293 K. If specific heat of water is  $4.184 \text{ J g}^{-1} \text{ K}^{-1}$ , then the final temperature of water is  
 (a) 288 K (b) 299 K (c) 279 K (d) 267 K

- 26.** Arrange the following gem-diols in decreasing order of their stability.



- (a) I > II > III      (b) III > II > I  
 (c) I > III > II      (d) III > I > II

- 27.** Aniline is treated with bromine water to give an organic compound 'X' which when treated with  $\text{NaNO}_2$  and HCl at  $0^\circ\text{C}$  gives a water soluble compound 'Y'. Compound 'Y' on treatment with  $\text{Cu}_2\text{Cl}_2$  and HCl gives compound 'Z'. Compound 'Z' is

- (a) *o*-bromochlorobenzene  
 (b) *p*-bromochlorobenzene  
 (c) 2, 4, 6-tribromophenol  
 (d) 2, 4, 6-tribromochlorobenzene.

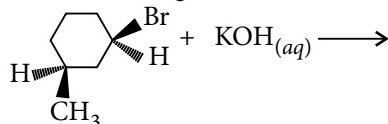
- 28.** On addition of 1 mL solution of 10% NaCl to 10 mL gold sol in the presence of 0.25 g of starch, the coagulation is just prevented. Starch has the gold number \_\_\_\_\_.

- (a) 0.025 (b) 0.25 (c) 0.5 (d) 250

- 29.** Which of the following reactions taking place in the blast furnace during extraction of iron is endothermic?

- (a)  $\text{CaCO}_3 \longrightarrow \text{CaO} + \text{CO}_2$   
 (b)  $2\text{C} + \text{O}_2 \longrightarrow 2\text{CO}$   
 (c)  $\text{C} + \text{O}_2 \longrightarrow \text{CO}_2$   
 (d)  $\text{Fe}_2\text{O}_3 + 3\text{CO} \longrightarrow 2\text{Fe} + 3\text{CO}_2$

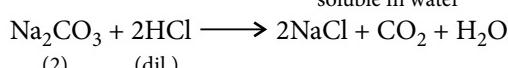
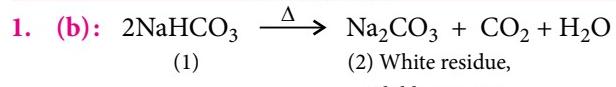
- 30.** In the following reaction,



the product formed is

- (a) (1*R*, 3*R*)-*cis*-3-methylcyclohexanol  
 (b) (1*R*, 3*S*)-*cis*-3-methylcyclohexanol  
 (c) (1*S*, 3*R*)-*trans*-3-methylcyclohexanol  
 (d) (1*S*, 3*S*)-*trans*-3-methylcyclohexanol.

### SOLUTIONS



- 2.** (a): Chloral ( $\text{CCl}_3\text{CHO}$ ) has no  $\alpha$ -hydrogen atom and hence, does not undergo aldol condensation.

**3.** (d): Atom A      Atom B  
 $Z = 8 \times \frac{1}{8} = 1$        $Z = 5 \times \frac{1}{2} = \frac{5}{2}$   
 $\Rightarrow A : B = 1 : \frac{5}{2}$        $\Rightarrow 2 : 5$

So, formula of compound will be  $A_2B_5$ .

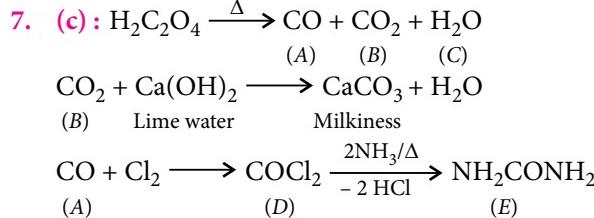
- 4.** (b): 10 mL of 1 M  $\text{KMnO}_4$  oxidises 10 mL of 5 M  $\text{FeSO}_4$  in acidic medium.

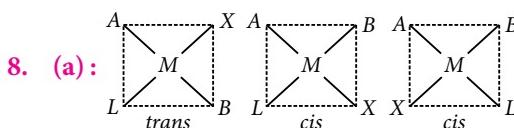


- 5.** (d): Natural rubber has the weakest intermolecular forces among the given *i.e.*, van der Waals' forces of attraction and is an example of an elastomer.

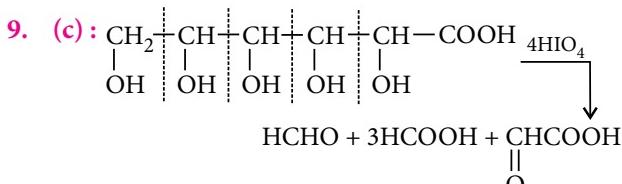
**6.** (b):  $-nFE_{\text{cell}}^{\circ} = -RT \ln K$  or  $E_{\text{cell}}^{\circ} = \frac{RT}{nF} \ln K$   
 Plot of  $\ln K$  vs  $E_{\text{cell}}^{\circ}$  will have slope  $= \frac{1}{2} \frac{RT}{F}$  ( $n = 2$ ).

This will only be possible when  $E_{\text{cell}}^{\circ} = 0.5$  which is for the line OB.

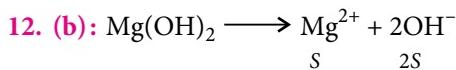
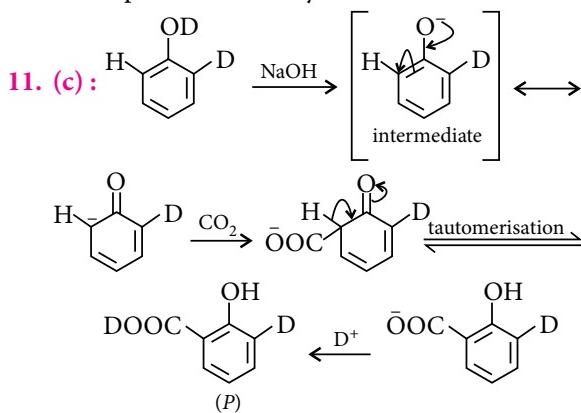




Thus, square planar complex  $MABXL$  shows two *cis* and one *trans* isomers.



10. (d): The equilibrium constant does not change at all with change in concentration, volume, pressure and presence of a catalyst. It changes only with change in temperature of the system.

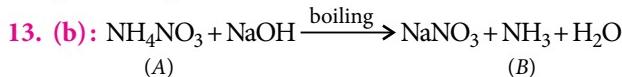


Let  $S_1$  is the solubility in 0.01 M  $\text{MgCl}_2$  (common ion  $\text{Mg}^{2+}$ ).  $\therefore [\text{Mg}^{2+}] = (S_1 + 0.01) \approx 0.01$ ;  $[\text{OH}^-] = 2S_1$

$$K_{sp} = (0.01)(2S_1)^2; S_1 = \left( \frac{K_{sp}}{4 \times 0.01} \right)^{1/2} = \left( \frac{10^{-12}}{4 \times 10^{-2}} \right)^{1/2} = 0.5 \times 10^{-5} \text{ M}$$

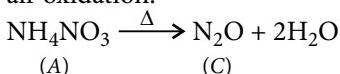
$$\therefore [\text{OH}^-] = 2S_1 = 2 \times 0.5 \times 10^{-5} = 10^{-5} \text{ M}$$

$$\text{pOH} = 5, \text{pH} = 14 - 5 = 9$$



$\text{NH}_3$  gives brown ppt. with Nessler's reagent ( $\text{K}_2\text{HgI}_4$ ).  
 $2\text{K}_2[\text{HgI}_4] + \text{NH}_3 + 3\text{KOH} \longrightarrow \text{H}_2\text{N}\cdot\text{HgO}\cdot\text{HgI}$   
Brown ppt.  
 $+ 7\text{KI} + 2\text{H}_2\text{O}$

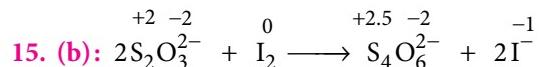
(A) on heating gives  $\text{N}_2\text{O}$  gas (C) which rekindles a glowing splinter but is not converted into  $\text{NO}_2$  by air oxidation.



14. (b): Energy absorbed in the ionisation of 1 mole of  $\text{Mg}_{(g)}$  to  $\text{Mg}^+_{(g)} = 750 \text{ kJ}$   
Energy unconsumed =  $1200 - 750 = 450 \text{ kJ mol}^{-1}$   
This energy is required to convert  $\text{Mg}_{(g)}$  to  $\text{Mg}^{2+}_{(g)}$ .

$$\text{Thus, \% of } \text{Mg}^{2+}_{(g)} = \frac{450}{1450} \times \frac{100}{1} = 31\% \text{ and \% of }$$

$$\text{Mg}^+_{(g)} = 100 - 31 = 69\%$$



$$\text{O.N. of S in } \text{S}_2\text{O}_3^{2-} = 2x - 6 = -2 \text{ or } x = +2$$

$$\text{O.N. of S in } \text{S}_4\text{O}_6^{2-} = 4x - 12 = -2 \text{ or } x = +2.5$$

$$\text{Change in O.N. of S per mole} = 0.5 \times 2 = 1$$

Similarly, change in O.N. of I per mole =  $1 \times 2 = 2$

Therefore, eq. mass of  $\text{Na}_2\text{S}_2\text{O}_3 = \frac{M_1}{1} = M_1$ , and  
eq. mass of  $\text{I}_2 = \frac{M_2}{2}$ .

16. (d):  $(I.E)_H = E_\infty - E_1 = -E_1 = x$

$$\text{Put } E_1 = -\frac{K}{n^2} = -\frac{K}{1^2} = -K; \therefore K = x$$

$$\Delta E = E_3 - E_2 = -\frac{K}{3^2} - \left( -\frac{K}{2^2} \right) = K \frac{5}{36} = \frac{5}{36} x$$

17. (c):  $H = U + PV$

$$H_1 = U_1 + (2 \times 3) = U_1 + 6$$

$$H_2 = U_2 + (4 \times 5) = U_2 + 20$$

$$(H_2 - H_1) = (U_2 - U_1) + (20 - 6)$$

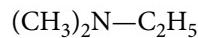
$$\Delta H = \Delta U + 14 = 30 + 14 = 44 \text{ L atm}$$

18. (a):  $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{NH}_2$

*n*-Butylamine (Primary amine)

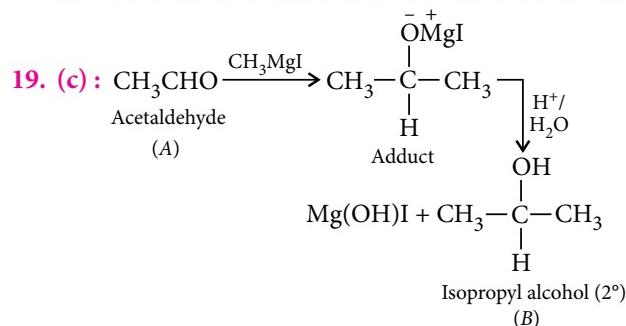


Diethylamine (Secondary amine)

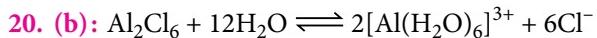


*N,N*-Dimethylethyl amine (Tertiary amine)

Primary amines have two hydrogen atoms available for hydrogen bond formation, while  $2^\circ$  amines have only one hydrogen atom.  $3^\circ$  amines do not have intermolecular association due to absence of hydrogen atom. Thus, order of boiling points of isomeric amines is as follows:  $3^\circ < 2^\circ < 1^\circ$  or III < II < I.



2° alcohols give blue coloured salt in Victor Meyer test.



21. (b): Given,  $t = \frac{2.303}{k_{298}} \log_{10} \frac{100}{90} = \frac{2.303}{k_{308}} \log_{10} \frac{100}{75}$   
 $\therefore \frac{k_{308}}{k_{298}} = 2.73$

Also,  $2.303 \log_{10} \frac{k_{308}}{k_{298}} = \frac{E_a}{R} \frac{T_2 - T_1}{T_1 T_2}$   
 $\therefore 2.303 \log_{10} 2.73 = \frac{E_a}{8.314} \times \frac{10}{298 \times 308}$   
 $\therefore E_a = 76.6227 \text{ kJ mol}^{-1}$

Now,  $k = Ae^{-E_a/RT}$   
 $k_{318} = 3.56 \times 10^9 \times e^{-76622.7/(8.314 \times 318)}$   
 $= 3.56 \times 10^9 \times 2.59 \times 10^{-13} = 9.22 \times 10^{-4} \text{ sec}^{-1}$

22. (a)

23. (c) : Gram atoms of helium gas formed in 1 hour

$$= \frac{11.2}{22400} = 5 \times 10^{-4}$$

i.e., Gram atoms of radioactive isotope disintegrated in one hour  $= 5 \times 10^{-4}$

Rate of disintegration  $= \lambda N$

$$5 \times 10^{-4} = \lambda \times 10 \text{ or } \lambda = 5 \times 10^{-5} \text{ hr}^{-1}$$

$$t_{1/2} = \frac{0.693}{\lambda} = \frac{0.693}{5 \times 10^{-5}} \text{ hr} = 13860 \text{ hr}$$

24. (c) : A – P, R; B – P, R; C – Q; D – S

Self reduction and carbon reduction are carried out in case of Pb and Cu. Ni is purified by the thermal decomposition of its carbonyl and Ti is purified by the decomposition of its iodide at higher temperature.

25. (b) : Since work is done against a constant pressure thus, irreversible.

Given,  $\Delta V = (6 - 4) = 2 \text{ L}$ ,  $P_{\text{ext}} = 2.5 \text{ atm}$   
 $\therefore W = -P_{\text{ext}} \times \Delta V = -2.5 \times 2 = -5 \text{ L atm}$   
 $= -\frac{5 \times 1.987}{0.0821} \text{ cal} = -\frac{5 \times 1.987 \times 4.184}{0.0821} \text{ J} = -506.31 \text{ J}$

Now, this work is used in heating 1 mole of water.

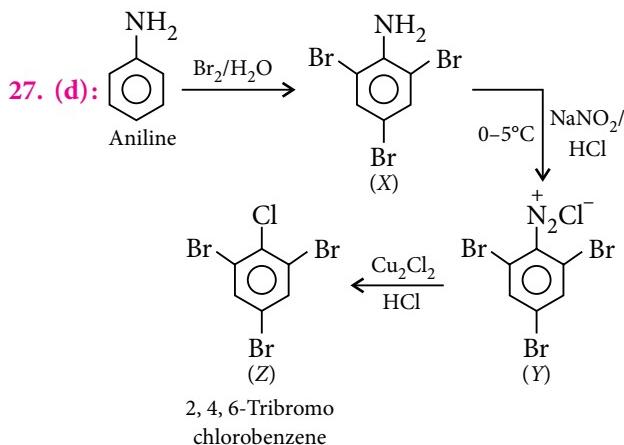
$$w = n \times C \times \Delta T$$

$$506.31 = 1 \times 4.184 \times 18 \times \Delta T \quad \left[ \because C = 4.184 \text{ J g}^{-1} \text{ K}^{-1} \right]$$

$$\therefore \Delta T = 6.723$$

So, final temperature  $= T_1 + \Delta T = 293 + 6.723$   
 $= 299.723 \text{ K}$

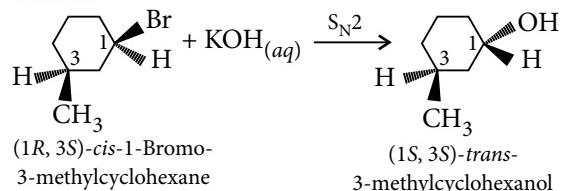
26. (a) : As the internal angle increases, steric hindrance increases and hence, the stability of the *gem*-diol decreases.



28. (d): By definition, gold number of starch is the amount of starch in mg added to 10 mL standard gold sol which prevents the coagulation of gold on adding 1 mL of 10% NaCl solution. And, the amount of starch is 0.25 g = 250 mg. Hence, gold number is 250.

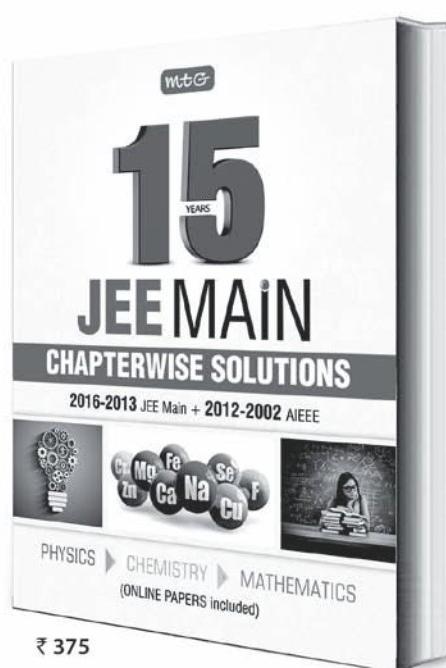
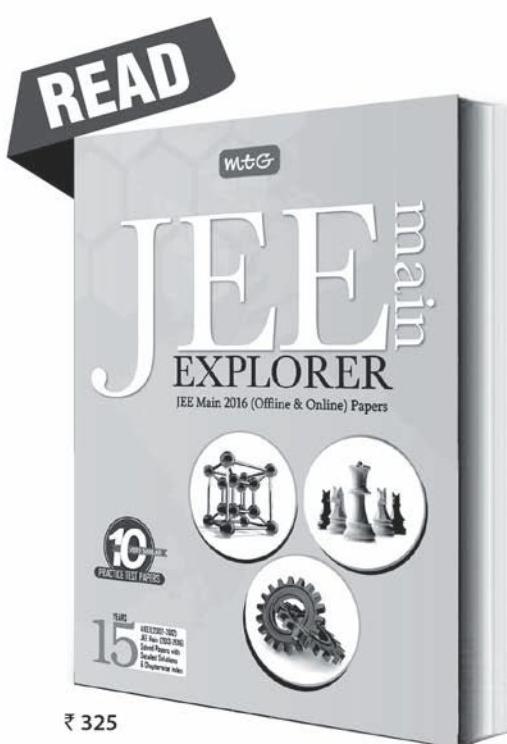
29. (b):  $2\text{C} + \text{O}_2 \longrightarrow 2\text{CO}; \Delta H = +\text{ve}$ ,  
It is an endothermic reaction.

30. (d): In  $\text{S}_{\text{N}}2$  reaction, inversion of configuration occurs.



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NEET	7 <sup>th</sup> May
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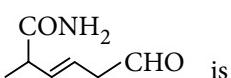


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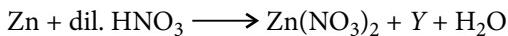
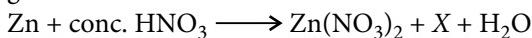
## Practice Paper 2017

1. The IUPAC name of the compound



- (a) 5-carbamoylhex-1-enal  
(b) 2-carbamoylhex-3-enal  
(c) 2-methyl-6-oxohex-3-enamide  
(d) 6-keto-2-methylhexanamide.

2. The following two reactions of  $\text{HNO}_3$  with Zn are given as :



The compounds X and Y respectively are

- (a)  $\text{NO}_2$  and NO      (b)  $\text{NO}_2$  and  $\text{NO}_2$   
(c) NO and  $\text{NO}_2$       (d)  $\text{NO}_2$  and  $\text{NH}_4\text{NO}_3$

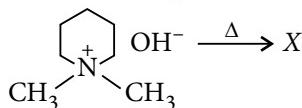
3. Which of the following has highest molar conductivity?

- (a) Diamminedichloroplatinum(II)  
(b) Tetraamminedichlorocobalt(III) chloride  
(c) Potassium hexacyanoferrate(II)  
(d) Pentacarbonyliron(0)

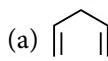
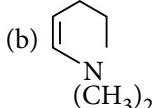
4. Sanger's reagent is used for the identification of

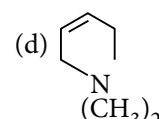
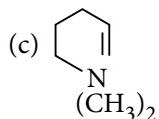
- (a) N-terminal of a peptide chain  
(b) C-terminal of a peptide chain  
(c) side chain of amino acids  
(d) molecular mass of the peptide chain.

5. In the following reaction,

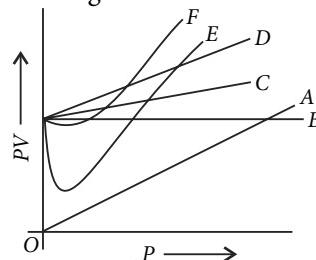


The organic product X is

- (a)   
(b) 



6. Which of the following curves represents the curve of an ideal gas?



- (a) B only      (b) C and D only  
(c) E and F only      (d) A and B only

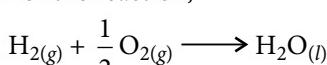
7. Which of the following species is the strongest base?

- (a)  $\text{^-OH}$       (b)  $\text{^-OR}$   
(c)  $\text{^-OC}_6\text{H}_5$       (d)  $\text{^-O}-\text{C}_6\text{H}_4-\text{NO}_2$

8. We have three aqueous solutions of NaCl labelled as 'A', 'B' and 'C' with concentrations 0.1 M, 0.01 M and 0.001 M, respectively. The value of van't Hoff factor for these solutions will be in the order

- (a)  $i_A < i_B < i_C$       (b)  $i_A > i_B > i_C$   
(c)  $i_A = i_B = i_C$       (d)  $i_A < i_B > i_C$

9. For the reaction,



$B.E.(\text{H} - \text{H}) = x_1$ ;  $B.E.(\text{O}=\text{O}) = x_2$  and  $B.E.(\text{O}-\text{H}) = x_3$ .

If the latent heat of vaporisation of water liquid into water vapour =  $x_4$ , then  $\Delta_f H$  (heat of formation of liquid water) is

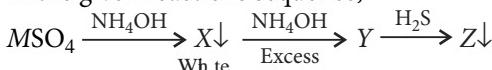
(a)  $x_1 + \frac{x_2}{2} - x_3 + x_4$

(b)  $2x_3 - x_1 - \frac{x_2}{2} - x_4$

(c)  $x_1 + \frac{x_2}{2} - 2x_3 - x_4$

(d)  $x_1 + \frac{x_2}{2} - 2x_3 + x_4$

10. In the given reactions sequence,



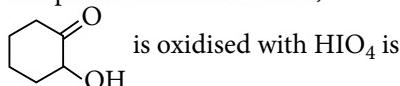
*M* and *Z* are respectively

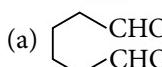
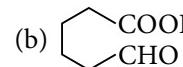
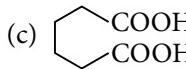
- (a) Zn, ZnS      (b) Al, Al<sub>2</sub>S<sub>3</sub>  
 (c) Cu, ZnS      (d) Fe, FeS

11. If the equilibrium constant of  $\text{BOH} \rightleftharpoons \text{B}^+ + \text{OH}^-$  at 25°C is  $2.5 \times 10^{-6}$ , then equilibrium constant for  $\text{BOH} + \text{H}^+ \rightleftharpoons \text{B}^+ + \text{H}_2\text{O}$  at the same temperature is

- (a)  $4.0 \times 10^{-9}$       (b)  $4.0 \times 10^5$   
 (c)  $2.5 \times 10^8$       (d)  $2.5 \times 10^{-6}$

12. The product obtained when,



- (a)       (b)   
 (c)       (d) 

13. Which is finally produced when acetylene reacts with HCl?

- (a)  $\text{CH}_2=\text{CHCl}$       (b)  $\text{CH}_3\text{CHCl}_2$   
 (c)  $\text{ClCH}=\text{CHCl}$       (d) ~~Natural gas~~

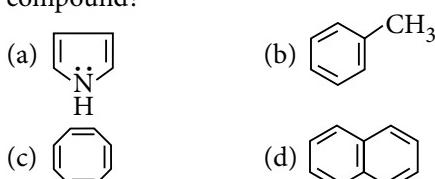
14. An unknown element forms an oxide. What will be the equivalent weight of the element if the oxygen content is 20% by weight?

- (a) 16 g      (b) 32 g  
 (c) 8 g      (d) 64 g

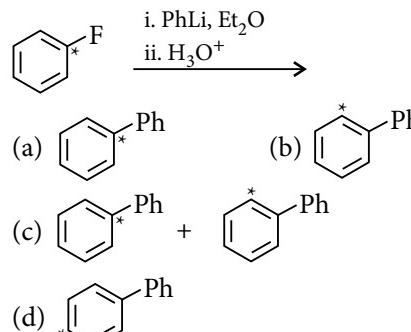
15. The ligand called  $\pi$ -acid is

- (a) CO      (b)  $\text{NH}_3$   
 (c)  $\text{C}_2\text{O}_4^{2-}$       (d) ethylenediamine.

16. Which of the following is an anti-aromatic compound?



17. Identify the product of the following reaction.



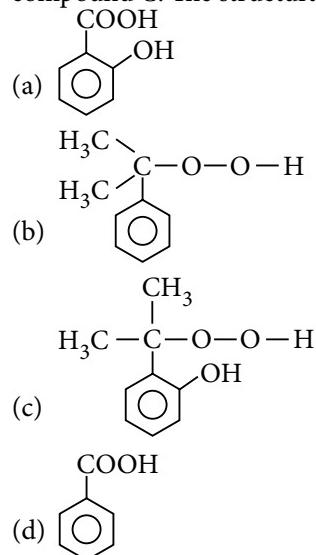
18. The successive ionisation enthalpy values for an element *X* are given as :

- 1<sup>st</sup> ionisation enthalpy = 410 kJ mol<sup>-1</sup>  
 2<sup>nd</sup> ionisation enthalpy = 820 kJ mol<sup>-1</sup>  
 3<sup>rd</sup> ionisation enthalpy = 1100 kJ mol<sup>-1</sup>  
 4<sup>th</sup> ionisation enthalpy = 1500 kJ mol<sup>-1</sup>  
 5<sup>th</sup> ionisation enthalpy = 3200 kJ mol<sup>-1</sup>

Find out the number of valence electrons for the atom *X*.

- (a) 4      (b) 3      (c) 5      (d) 2

19. Phenol is distilled with Zn dust followed by Friedel-Crafts alkylation with propyl chloride in the presence of  $\text{AlCl}_3$  to give a compound *B*. *B* is oxidised in the presence of air to form the compound *C*. The structural formula of *C* is



20.  $\Lambda_m^\circ(\text{NH}_4\text{OH})$  is equal to

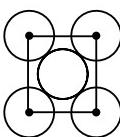
- (a)  $\Lambda_m^\circ(\text{NH}_4\text{OH}) + \Lambda_m^\circ(\text{NH}_4\text{Cl}) - \Lambda_m^\circ(\text{HCl})$   
 (b)  $\Lambda_m^\circ(\text{NH}_4\text{Cl}) + \Lambda_m^\circ(\text{NaOH}) - \Lambda_m^\circ(\text{NaCl})$   
 (c)  $\Lambda_m^\circ(\text{NH}_4\text{Cl}) + \Lambda_m^\circ(\text{NaCl}) - \Lambda_m^\circ(\text{NaOH})$   
 (d)  $\Lambda_m^\circ(\text{NaOH}) + \Lambda_m^\circ(\text{NaCl}) - \Lambda_m^\circ(\text{NH}_4\text{Cl})$

- 21.** At the equilibrium position in the process of adsorption  
 (a)  $\Delta H > 0$       (b)  $\Delta H = T\Delta S$   
 (c)  $\Delta H > T\Delta S$       (d)  $\Delta H < T\Delta S$

- 22.** Distinction between primary, secondary and tertiary alcohols is done by  
 (a) oxidation method  
 (b) Lucas test  
 (c) Victor Meyer method  
 (d) all of these.

- 23.** The frequency of radiation emitted when the electron falls from  $n = 4$  to  $n = 1$  in a hydrogen atom will be  
 (a)  $3.08 \times 10^{15} \text{ s}^{-1}$       (b)  $2.00 \times 10^{15} \text{ s}^{-1}$   
 (c)  $1.54 \times 10^{15} \text{ s}^{-1}$       (d)  $1.03 \times 10^{15} \text{ s}^{-1}$

- 24.** The packing efficiency of the two dimensional square unit cell shown is  
 (a) 39.27%      (b) 68.02%  
 (c) 74.05%      (d) 78.54%



- 25.** In Ramsay and Rayleigh's isolation of noble gases from air, the nitrogen of the air is finally converted into  
 (a)  $\text{NaNO}_2$  only      (b)  $\text{NO}$  and  $\text{NO}_2$   
 (c)  $\text{NaNO}_3$  only      (d)  $\text{NaNO}_2$  and  $\text{NaNO}_3$

- 26.** The gold number of some colloidal solutions are given as :

Colloidal solution	Gold number
A	0.01
B	2.5
C	20

The protective nature of these colloidal solutions follows the order

- (a)  $C > B > A$       (b)  $A > B > C$   
 (c)  $A = B = C$       (d)  $B > A > C$
- 27.**  $\text{CH}_3\text{CH}_2\text{NH}_2$  contains a basic  $\text{NH}_2$  group, but  $\text{CH}_3\text{CONH}_2$  does not  
 (a) acetamide is amphoteric in character  
 (b) in ethyl amine the electron pair on N-atom is delocalised by resonance  
 (c) in ethyl amine there is no resonance while in acetamide the lone pair of electrons on N-atom is delocalised and is less available for protonation  
 (d) all of these.

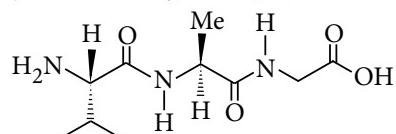
- 28.** Match the options given in column I with column II.

Column I	Column II
P. Mathematical expression for rate of reaction	1. rate constant
Q. Rate of reaction for zero order reaction is equal to	2. rate law
R. Units of rate constant for zero order reaction is same as that of	3. order of slowest step
S. Order of a complex reaction is determined by	4. rate of the reaction
P    Q    R    S	
(a) 1    2    4    3	
(b) 3    4    1    2	
(c) 2    1    4    3	
(d) 2    1    3    4	

- 29.** The thermal stability of the hydrides of O, S, Se and Te varies in the order

- (a)  $\text{H}_2\text{Te} > \text{H}_2\text{Se} > \text{H}_2\text{S} > \text{H}_2\text{O}$   
 (b)  $\text{H}_2\text{O} > \text{H}_2\text{S} > \text{H}_2\text{Se} > \text{H}_2\text{Te}$   
 (c)  $\text{H}_2\text{O} > \text{H}_2\text{Se} > \text{H}_2\text{Te} > \text{H}_2\text{S}$   
 (d)  $\text{H}_2\text{S} > \text{H}_2\text{O} > \text{H}_2\text{Se} > \text{H}_2\text{Te}$

- 30.** Which of the following amino acids can be used to synthesise the given tripeptide ?



- (a) Glycine, leucine and alanine  
 (b) Alanine, isoleucine and glycine  
 (c) Valine, alanine and glycine  
 (d) Alanine, serine and glycine

- 31.** In the anion  $\text{HCOO}^-$  the two carbon-oxygen bonds are found to be of equal length because

- (a) the  $\text{C=O}$  bond is weaker than the  $\text{C—O}$  bond  
 (b) the anion  $\text{HCOO}^-$  shows resonance  
 (c) the anion is obtained by removal of a proton from the acid molecule  
 (d) the electronic orbitals of carbon atom are hybridised.

- 32.** In chromic acid anhydride ( $\text{CrO}_3$ ), Cr has  $d^0$  configuration but it is bright orange coloured solid, the colour is due to

Which of the following sets of quantum number is not possible?

	<i>n</i>	<i>l</i>	<i>m</i>	<i>s</i>
(i)	3	0	0	+1/2
(ii)	2	2	1	+1/2
(iii)	4	3	-2	-1/2
(iv)	1	0	-1	-1/2
(v)	3	2	3	+1/2



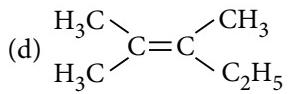
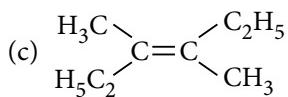
**42.** Match the polymers given in column I with their chemical names given in column II.

Column I	Column II
P. Nylon 6	1. Polyvinyl chloride
Q. PVC	2. Polyacrylonitrile
R. Acrilan	3. Polycaprolactum
S. Natural rubber	4. <i>cis</i> -Polyisoprene
<b>P    Q    R    S</b>	
(a) 1    2    3    4	
(b) 4    3    1    2	
(c) 3    1    4    2	
(d) 3    1    2    4	

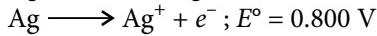
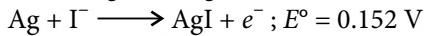
43. Which of the following will not show geometrical isomerism?

(a)

(b)



44. Following data is given at 25°C,



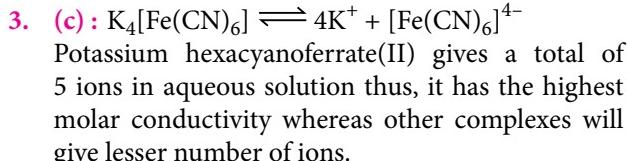
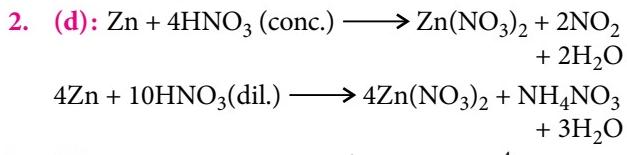
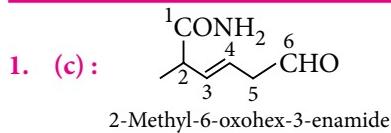
What is the value of  $\log K_{sp}$  for AgI?

- (a) -37.83      (b) -16.13  
 (c) -8.12      (d) +8.612

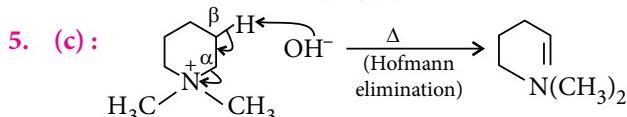
45. Antiseptic action of dettol is due to

- (a) 4-chloro-3, 5-dimethylphenol  
 (b) 3-chloro-4, 5-dimethylphenol  
 (c) 4-chloro-2, 5-dimethylphenol  
 (d) 5-chloro-3, 4-dimethylphenol.

### SOLUTIONS



4. (a): Sanger's reagent is used for the identification of N-terminal residue of a polypeptide.



6. (a): For curve B, the value of PV is constant and for an ideal gas, plot of PV vs P is a straight line, parallel to x-axis.

7. (b):  $^-\text{OR}$  is the strongest base since R (alkyl) group is an electron releasing group which increases electron density on oxygen.

8. (c): The value of van't Hoff factor for the given solutions will be the same, i.e.,  $i_A = i_B = i_C$  due to complete dissociation of NaCl (strong electrolyte) in dilute solutions. On complete dissociation value of  $i$  for NaCl is 2.

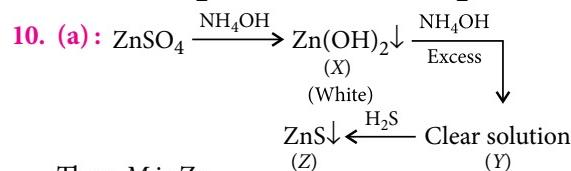
9. (c):  $\Delta_f H = (\text{B.E.})_{\text{reactants}} - (\text{B.E.})_{\text{products}}$

But all the species must be in gaseous state, so in product  $[\text{H}_2\text{O}_{(l)} \rightarrow \text{H}_2\text{O}_{(g)}]$   $\Delta H_{\text{vap}}$  must be added.

Hence for the reaction,  $\text{H}_{2(g)} + \frac{1}{2}\text{O}_{2(g)} \rightarrow \text{H}_2\text{O}_{(l)}$

$$\Delta_f H = \left[ (\text{B.E.})_{\text{H-H}} + \frac{1}{2}(\text{B.E.})_{\text{O=O}} \right] - [\Delta H_{\text{vap}} + 2(\text{B.E.})_{\text{O-H}}]$$

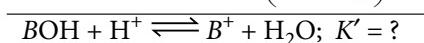
$$= x_1 + \frac{x_2}{2} - [x_4 + 2x_3] \Rightarrow x_1 + \frac{x_2}{2} - x_4 - 2x_3$$



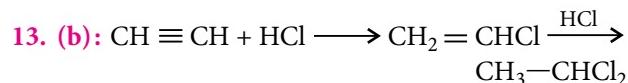
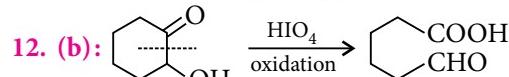
Thus, M is Zn.

11. (c):  $\text{BOH} \rightleftharpoons \text{B}^+ + \bar{\text{O}}\text{H}; (K_b = 2.5 \times 10^{-6})$

$$\text{H}^+ + \bar{\text{O}}\text{H} \rightleftharpoons \text{H}_2\text{O}; \left( K = \frac{1}{K_w} \right)$$



$$\therefore K' = K_b \times \frac{1}{K_w} = \frac{2.5 \times 10^{-6}}{10^{-14}} = 2.5 \times 10^8$$

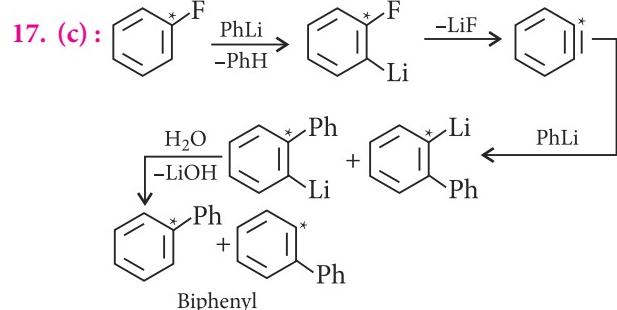


14. (b): Given that oxygen content is 20% by weight, then

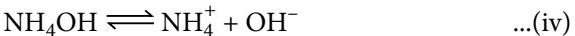
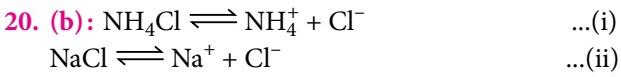
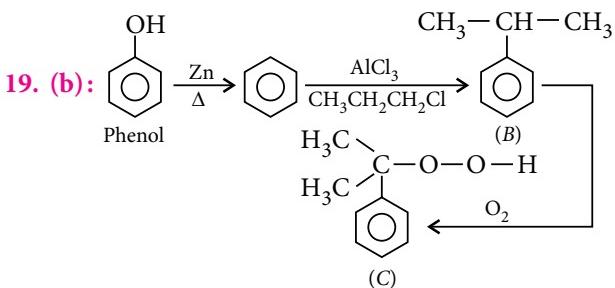
$$\text{eq. wt. of unknown element} = \frac{8}{\frac{8}{20}} \times 8 \text{ g} = 32 \text{ g}$$

15. (a)

16. (c): Planar conjugated cyclic compounds containing  $4n\pi$  electrons are anti-aromatic, e.g., cyclooctatetraene ( $8\pi e^-$ s).



18. (a): Removal of 5<sup>th</sup> electron requires almost more than double the energy required for removing 4<sup>th</sup> electron. Therefore, the valence electrons should be 4.



Applying (i) + (iii) - (ii) to get the equation (iv),

$$\Delta_m^\circ(\text{NH}_4\text{Cl}) + \Delta_m^\circ(\text{NaOH}) - \Delta_m^\circ(\text{NaCl}) = \Delta_m^\circ(\text{NH}_4\text{OH})$$

21. (b): At equilibrium during adsorption,  $\Delta G = 0$  and  $\Delta H$  becomes equal to  $T\Delta S$ .

22. (d)

23. (a):  $E_n = \frac{-2.18 \times 10^{-18}}{n^2} \text{ J atom}^{-1}$

$$\Delta E = E_4 - E_1 = -2.18 \times 10^{-18} \left( \frac{1}{4^2} - \frac{1}{1^2} \right)$$

$$= -2.18 \times 10^{-18} (-0.9375) \Rightarrow 2.043 \times 10^{-18} \text{ J atom}^{-1}$$

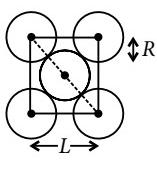
Also,  $\Delta E = h\nu$

$$\therefore \nu = \frac{\Delta E}{h} = \frac{2.043 \times 10^{-18}}{6.625 \times 10^{-34}} = 3.08 \times 10^{15} \text{ s}^{-1}$$

24. (d):  $4R = L\sqrt{2}$

so,  $L = 2\sqrt{2}R$

$$\begin{aligned} \text{Area of square unit cell} &= (2\sqrt{2}R)^2 \\ &= 8R^2 \end{aligned}$$

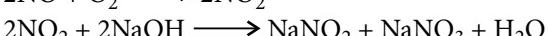


Area of atoms present in one unit cell

$$= \pi R^2 + 4 \left( \frac{\pi R^2}{4} \right) = 2\pi R^2$$

$$\text{So, packing efficiency} = \frac{2\pi R^2}{8R^2} \times 100 = \frac{\pi}{4} \times 100 \approx 78.54\%$$

25. (d): Nitrogen is finally converted into  $\text{NaNO}_2$  and  $\text{NaNO}_3$  in Ramsay and Rayleigh's method.



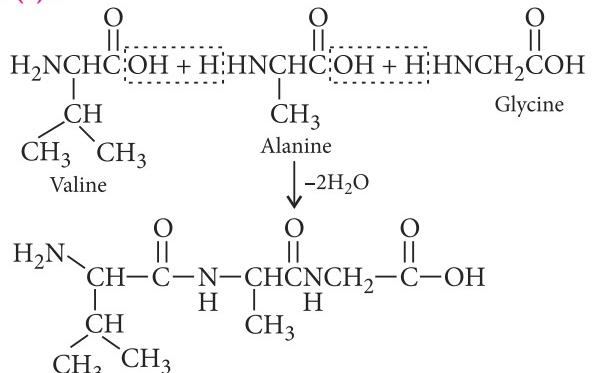
26. (b): Higher the gold number, lower will be the protective power of a colloidal solution.

27. (c)

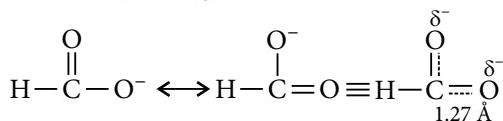
28. (c)

29. (b): Thermal stability decreases as the size of atom increases (down the group). Thus,  $\text{H}_2\text{O}$  is most stable and  $\text{H}_2\text{Te}$  is least stable.

30. (c):



31. (b): As the anion  $\text{HCOO}^-$  has two resonating structures, so the carbon-oxygen bonds are found to be of equal length.

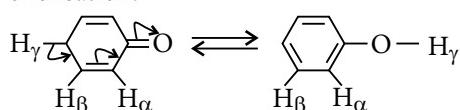


32. (b): The colour of  $\text{CrO}_3$  ( $d^0$  configuration) is due to charge transfer from ligand (oxygen) to metal (chromium) and not due to  $d-d$  transition.

33. (d): Dissolving salt in a solvent or liquid lowers the vapour pressure.

34. (b): Lactose on hydrolysis with acetic acid gives glucose and galactose.

35. (c):  $\text{H}_\gamma$  being located on a saturated carbon is more labile than  $\text{H}_\alpha$  and  $\text{H}_\beta$  and hence, is involved in enolisation.



36. (a):  $\text{NO}_3^- < \text{O}^- < \text{P}^- < \text{Ph}_3$

Weak field ligand      Strong field ligand

37. (a):  $\text{Pb}_3\text{O}_4 + 4\text{NO}_3^- \longrightarrow \text{PbO}_2 \downarrow + 2\text{Pb}(\text{NO}_3)_2$

Scarlet compound      Brown ppt.      Colourless solution

(A)                    (B)                    (C)

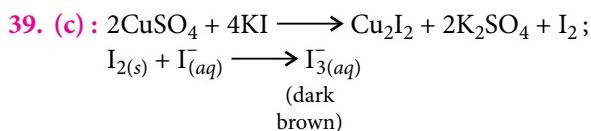


38. (b): (i) represents an electron in 3s orbital.

(ii) is not possible as value of  $l$  varies from 0 to  $(n-1)$ .

(iii) represents an electron in 4f orbital.

(iv) is not possible as value of  $m$  varies from  $-l$  to  $+l$ .  
 (y is n p sib e as x le b m x ries frm -l to +l, itc an w rb g eatert h n l.



**40. (b):** Zn-Hg and conc. HCl reduces aldehydes and ketones but carboxylic acid group remains unaffected.

**41. (c):** O.N. of N in  $\text{N}_2\text{H}_4$  is  $-2$  which changes to  $0$  in  $\text{N}_2$ .

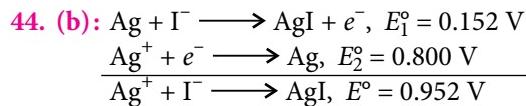
Hence, eq. mass of  $\text{N}_2\text{H}_4 = \frac{\text{molar mass}}{2 \times 2} = \frac{32}{4} = 8$

O.N. of iodine changes from  $+5$  in  $\text{IO}_3^-$  to  $+1$  in  $\text{ICl}$ .

Hence, eq. mass of  $\text{KIO}_3 = \frac{\text{molar mass}}{4} = \frac{214}{4} = 53.5$

**42. (d)**

**43. (d):**  $\begin{array}{c} \text{H}_3\text{C} \\ | \\ >\text{C}=\text{C} \\ | \\ \text{H}_3\text{C} \end{array} \begin{array}{c} \text{CH}_3 \\ | \\ <\text{C}_2\text{H}_5 will not show geometrical isomerism due to the presence of similar alkyl groups on the same carbon atom of double bond.$



At equilibrium,  $E^\circ = \frac{2.303RT}{F} \log K_c$

But  $K_c = \frac{[\text{AgI}]}{[\text{Ag}^+][\text{I}^-]} = \frac{1}{K_{sp}}$

$\therefore 0.952 = \frac{2.303RT}{F} \log K_{sp} = -0.059 \log K_{sp}$

or  $\log K_{sp} = -16.13$

**45. (a):** 4-Chloro-3,5-dimethylphenol, also called chloroxylenol has antiseptic properties.

## NEET 2017\*

### NOTIFICATION!

Candidates can apply for NEET "Online" only. No offline application will be entertained. All candidates are allowed a maximum of 3 attempts. Information Bulletin can be downloaded from the website [www.cbseneet.nic.in](http://www.cbseneet.nic.in). Aadhaar number is required for submission of Application Form of NEET-2017. The use of Aadhaar for the candidates of NEET-2017 will result in accuracy of the candidate's details.

As per regulations framed under the Indian Medical Council Act-1956 as amended in 2016 and the Dentists Act-1948 as amended in 2016, NATIONAL ELIGIBILITY CUM ENTRANCE TEST – 2017 (NEET-2017) will be conducted by the Central Board of Secondary Education (CBSE), for admission to MBBS/BDS Courses in India in Medical/Dental Colleges run with the approval of Medical Council of India/Dental Council of India under the Union Ministry of Health and Family Welfare, Government of India except for the institutions established through an Act of Parliament i.e. AIIMS and JIPMER Puducherry.

#### DATE OF ENTRANCE TEST

NATIONAL ELIGIBILITY CUM ENTRANCE TEST will be conducted on Sunday, the 7<sup>th</sup> May, 2017 from 10:00 am to 01:00 pm. The duration of test will be 3 hours.

#### PATTERN OF THE ENTRANCE TEST

The Entrance Test shall consist of one paper containing 180 objective type questions (four options with single correct answer) from Physics, Chemistry and Biology (Botany & Zoology) to be answered on the specially designed machine-readable sheet using Ball Point Pen provided by CBSE at examination centre only.

(i) Candidates can opt for Question Paper in either of the following

languages (As per letter nos. V.11025/35/2012-MEP(Pt.) dated 08.12.2016 & 16.01.2017 received from MoH&FW)

HINDI	ENGLISH	GUJARATI	MARATHI	ORIYA
BENGALI	ASSAMESE	TELUGU	TAMIL	KANNADA

- (ii) Option of medium of Question Paper should be exercised while filling in the application form and the option once exercised by candidates cannot be changed later.
- (iii) Candidates opting for English would be provided Test Booklet in English only.
- (iv) Candidates opting for Hindi would be provided Bilingual Test Booklet i.e. in Hindi and in English.
- (v) Candidates opting for vernacular languages would be provided Bilingual Test Booklet i.e. in selected language and in English.

#### SYLLABUS

The Question Papers for the test shall be based on a common syllabus notified by the Medical Council of India.

#### IMPORTANT INFORMATION AT A GLANCE

Schedule for online submission of application forms	31.01.2017 to 1.03.2017
Last date for successful final transaction of fee	01.03.2017
Date of uploading of Admit-Cards on website	15.04.2017
Date of examination, NEET-2017	07.05.2017
Declaration of Result	08.06.2017

\*For more details, please refer to latest prospectus.

# PRACTICE PAPER

# BITSAT

Exam date:  
16<sup>th</sup> to 30<sup>th</sup>  
May 2017

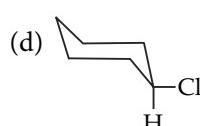
- Which of the following reactions show the reducing property of hydrochloric acid?
  - $\text{ZnCO}_3 + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2\text{O} + \text{CO}_2$
  - $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$
  - $\text{MnO}_2 + 4\text{HCl} \rightarrow \text{MnCl}_2 + 2\text{H}_2\text{O} + \text{Cl}_2$
  - $\text{NH}_4\text{OH} + \text{HCl} \rightarrow \text{NH}_4\text{Cl} + \text{H}_2\text{O}$
- Reduction potentials of some ions are given below. Arrange them in decreasing order of oxidising power.
 

Ion	$\text{ClO}_4^-$	$\text{IO}_4^-$	$\text{BrO}_4^-$
Reduction potential ( $E^\circ$ )	1.19 V	1.65 V	1.74 V

  - $\text{ClO}_4^- > \text{IO}_4^- > \text{BrO}_4^-$
  - $\text{IO}_4^- > \text{BrO}_4^- > \text{ClO}_4^-$
  - $\text{BrO}_4^- > \text{IO}_4^- > \text{ClO}_4^-$
  - $\text{BrO}_4^- > \text{ClO}_4^- > \text{IO}_4^-$
- Which of the following will not give iodoform test?
  - n*-Butyl alcohol
  - sec*-Butyl alcohol
  - Acetophenone
  - Acetaldehyde
- Energy of an electron in hydrogen atom is given by  $E = -\frac{13.6}{n^2}$  eV. Which one of the following statements is true if  $n$  is changed from 1 to 3? Energy will
  - decrease three times
  - increase three times
  - increase nine times
  - decrease nine times.
- In the coagulation of a positive sol, the flocculation powers of  $\text{Cl}^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{PO}_4^{3-}$  and  $[\text{Fe}(\text{CN})_6]^{4-}$  are in the order
  - $\text{Cl}^- > \text{SO}_4^{2-} > [\text{Fe}(\text{CN})_6]^{4-} > \text{PO}_4^{3-}$
  - $\text{Cl}^- > \text{PO}_4^{3-} > \text{SO}_4^{2-} > [\text{Fe}(\text{CN})_6]^{4-}$
  - $[\text{Fe}(\text{CN})_6]^{4-} > \text{PO}_4^{3-} > \text{SO}_4^{2-} > \text{Cl}^-$
  - $\text{Cl}^- > \text{SO}_4^{2-} > \text{PO}_4^{3-} > [\text{Fe}(\text{CN})_6]^{4-}$
- Which of the following complexes formed by  $\text{Cu}^{2+}$  ions is most stable?
  - $\text{Cu}^{2+} + 4\text{NH}_3 \rightleftharpoons [\text{Cu}(\text{NH}_3)_4]^{2+}; \log K = 11.6$
  - $\text{Cu}^{2+} + 4\text{CN}^- \rightleftharpoons [\text{Cu}(\text{CN})_4]^{2-}; \log K = 27.3$
  - $\text{Cu}^{2+} + 2\text{en} \rightleftharpoons [\text{Cu}(\text{en})_2]^{2+}; \log K = 15.4$
  - $\text{Cu}^{2+} + 4\text{H}_2\text{O} \rightleftharpoons [\text{Cu}(\text{H}_2\text{O})_4]^{2+}; \log K = 8.9$
- The correct decreasing order of acidic character is
  - $\text{HClO} > \text{HBrO} > \text{HIO}$
  - $\text{HIO} > \text{HBrO} > \text{HClO}$
  - $\text{HBrO} > \text{HIO} > \text{HClO}$
  - $\text{HClO} > \text{HIO} > \text{HBrO}$
- Cellulose, the most important constituent of plant cell wall, is made up of
  - branched chain of glucose molecules linked by  $\alpha (1 \rightarrow 6)$  glycosidic bonds at the site of branching
  - unbranched chain of glucose molecules linked by  $\alpha (1 \rightarrow 4)$  glycosidic bonds
  - branched chain of glucose molecules linked by  $\beta (1 \rightarrow 4)$  glycosidic bond in straight chain and  $\alpha (1 \rightarrow 6)$  glycosidic bond at the site of branching
  - unbranched chain of glucose molecules linked by  $\beta (1 \rightarrow 4)$  glycosidic bonds.
- 1.020 g of metallic oxide contains 0.540 g of the metal. If the specific heat of the metal,  $M$  is  $0.216 \text{ cal deg}^{-1}\text{g}^{-1}$ , the molecular formula of its oxide is
  - $\text{MO}$
  - $\text{M}_2\text{O}_3$
  - $\text{M}_2\text{O}_4$
  - $\text{M}_2\text{O}$
- The most stable conformation of chlorocyclohexane at room temperature is
 

(a)

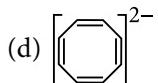
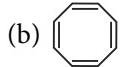
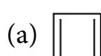
(b)

- 11.** Identify the correct statement for change in Gibbs' energy for a system ( $\Delta G_{system}$ ) at constant temperature and pressure.
- If  $\Delta G_{system} = 0$ , the system has attained equilibrium.
  - If  $\Delta G_{system} = 0$ , the system is still moving in a particular direction.
  - If  $\Delta G_{system} = 0$ , the process is not spontaneous.
  - If  $\Delta G_{system} = 0$ , the process is spontaneous.
- 12.** The emf of the three galvanic cells given below are represented by  $E_1$ ,  $E_2$  and  $E_3$ .
- Zn | Zn<sup>2+</sup> (1 M) || Cu<sup>2+</sup> (1 M) | Cu
  - Zn | Zn<sup>2+</sup> (0.1 M) || Cu<sup>2+</sup> (1 M) | Cu
  - Zn | Zn<sup>2+</sup> (1 M) || Cu<sup>2+</sup> (0.1 M) | Cu
- Which of the following is true?
- $E_1 > E_2 > E_3$
  - $E_3 > E_2 > E_1$
  - $E_3 > E_1 > E_2$
  - $E_2 > E_1 > E_3$
- 13.** 1500 mL flask contains 400 mg O<sub>2</sub> and 60 mg H<sub>2</sub> at 100°C. What is the total pressure in the flask?
- 0.66 atm
  - 0.867 atm
  - 8.67 atm
  - 13.47 atm
- 14.** Which of the following does not represent the correct order of the property indicated?
- Sc<sup>3+</sup> > Cr<sup>3+</sup> > Fe<sup>3+</sup> > Mn<sup>3+</sup> : Ionic radii
  - Sc < Ti < Cr < Mn : Density
  - Mn<sup>2+</sup> > Ni<sup>2+</sup> < Co<sup>2+</sup> < Fe<sup>2+</sup> : Ionic radii
  - FeO < CaO > MnO > CuO : Basic nature
- 15.** A red coloured oxide (X) on treatment with conc. HNO<sub>3</sub> gives a compound (Y). (Y) with HCl produces a chloride (Z) which is insoluble in cold water but soluble in hot water. (Z) can also be formed by treating (X) with conc. HCl. Compounds X, Y and Z are
- Pb<sub>3</sub>O<sub>4</sub>, PbO<sub>2</sub>, PbCl<sub>2</sub>
  - Mn<sub>3</sub>O<sub>4</sub>, MnO<sub>2</sub>, MnCl<sub>2</sub>
  - Fe<sub>3</sub>O<sub>4</sub>, Fe<sub>2</sub>O<sub>3</sub>, FeCl<sub>3</sub>
  - Fe<sub>3</sub>O<sub>4</sub>, FeO, FeCl<sub>2</sub>
- 16.** Which is not true about the coordination compound [Co(en)<sub>2</sub>Cl<sub>2</sub>]Cl?
- It exhibits geometrical isomerism.
  - It exhibits optical isomerism.
  - It exhibits ionisation isomerism.
  - It is an octahedral complex.

- 17.** Polarity in a molecule and hence, the dipole moment depends primarily on electronegativity of the constituent atoms and shape of a molecule. Which of the following has the highest dipole moment?
- CO<sub>2</sub>
  - HI
  - H<sub>2</sub>O
  - SO<sub>2</sub>
- 18.** The rapid change of pH near the stoichiometric point of an acid-base titration is the basis of indicator detection. pH of the solution is related to the ratio of the concentration of conjugate acid (HIn) and base (In<sup>-</sup>) forms of the indicator by the expression
- $\log \frac{[\text{In}^-]}{[\text{HIn}]} = pK_a + \text{pH}$
  - $\log \frac{[\text{HIn}]}{[\text{In}^-]} = K_a + \text{pH}$
  - $\log \frac{[\text{HIn}]}{[\text{In}^-]} = \text{pH} - pK_a$
  - $\log \frac{[\text{In}^-]}{[\text{HIn}]} = \text{pH} - pK_a$
- 19.** Correct set of four quantum numbers for the valence (outermost) electron of rubidium ( $Z = 37$ ) is
- $5, 0, 0, +\frac{1}{2}$
  - $5, 1, 0, +\frac{1}{2}$
  - $5, 1, 1, +\frac{1}{2}$
  - $6, 0, 0, +\frac{1}{2}$
- 20.** If  $K_{sp}[\text{AgCNS}] = 1 \times 10^{-12}$  and  $K_{sp}[\text{AgBr}] = 5 \times 10^{-13}$  then the value of simultaneous solubility of AgCNS and AgBr in a solution of water will be
- $8.16 \times 10^{-7}, 4.08 \times 10^{-7}$
  - $4.08 \times 10^{-7}, 8.16 \times 10^{-7}$
  - 8.16, 4.08
  - $1 \times 10^{-12}, 5 \times 10^{-13}$
- 21.** Which of the following reactions depicts the oxidising property of SO<sub>2</sub>?
- SO<sub>2</sub> + H<sub>2</sub>O  $\rightarrow$  H<sub>2</sub>SO<sub>3</sub>
  - 2H<sub>2</sub>S + SO<sub>2</sub>  $\rightarrow$  3S + 2H<sub>2</sub>O
  - Cl<sub>2</sub> + SO<sub>2</sub>  $\rightarrow$  SO<sub>2</sub>Cl<sub>2</sub>
  - $2\text{MnO}_4^- + 5\text{SO}_2 + 2\text{H}_2\text{O} \rightarrow 5\text{SO}_4^{2-} + 2\text{Mn}^{2+} + 4\text{H}^+$
- 22.** 500 mL of a hydrocarbon gas burnt in excess of oxygen yielded 2500 mL of CO<sub>2</sub> and 3.0 L of water vapour. The formula of the hydrocarbon is
- C<sub>5</sub>H<sub>12</sub>
  - CH<sub>4</sub>
  - C<sub>2</sub>H<sub>4</sub>
  - C<sub>3</sub>H<sub>6</sub>
- 23.** The compound in which carbon uses only  $sp^3$ -hybrid orbitals for bond formation is
- (CH<sub>3</sub>)<sub>3</sub>C—CHO
  - (CH<sub>3</sub>)<sub>3</sub>C—OH
  - NH<sub>2</sub>CONH<sub>2</sub>
  - HCOOH

**24.** Which among the following is aromatic?



**25.**  $RCH_2CH_2OH$  can be converted to  $RCH_2CH_2COOH$  by the following sequence of reagents.

- (a)  $PBr_3$ ,  $KCN$ ,  $H_3O^+$     (b)  $PBr_3$ ,  $KCN$ ,  $H_2/Pt$   
 (c)  $KCN$ ,  $H_3O^+$     (d)  $HCN$ ,  $PBr_3$ ,  $H_3O^+$

**26.** Which of the following statements is not true?

- (a) London smog is a mixture of smoke and fog.  
 (b) London smog is oxidising in nature.  
 (c) Photochemical smog causes irritation in eyes.  
 (d) Photochemical smog results in the formation of PAN.

**27.** An element with molar mass  $2.7 \times 10^{-2}$  kg mol $^{-1}$  forms a cubic unit cell with edge length 405 pm. If its density is  $2.7 \times 10^3$  kg m $^{-3}$ , what is the nature of the cubic unit cell?

- (a) Simple cubic    (b) Face-centred  
 (c) Body-centred    (d) End-centred

**28.** The ease of dehydrohalogenation with alcoholic KOH in case of 1-Chloroethane (I), 2-Chloropropane (II) and 2-Chloro-2-methylpropane (III) is of the order

- (a) III > II > I    (b) I > II > III  
 (c) II > I > III    (d) I > III > II

**29.** The correct order of reactivity towards electrophilic substitution is

- (a) benzene > phenol > benzoic acid > chlorobenzene  
 (b) phenol > benzene > chlorobenzene > benzoic acid  
 (c) chlorobenzene > benzoic acid > phenol > benzene  
 (d) benzoic acid > chlorobenzene > benzene > phenol.

**30.** For a reaction,  $2K_{(g)} + L_{(g)} \rightarrow 2M_{(g)}$ ;  $\Delta U^\circ = -10.5$  kJ and  $\Delta S^\circ = -44.1$  J K $^{-1}$ . Calculate  $\Delta G^\circ$  for the reaction and predict whether the reaction will be spontaneous or non-spontaneous?

- (a)  $\Delta G^\circ = +0.16$  kJ, non-spontaneous  
 (b)  $\Delta G^\circ = -0.16$  kJ, spontaneous  
 (c)  $\Delta G^\circ = +26.12$  kJ, non-spontaneous  
 (d)  $\Delta G^\circ = -26.12$  kJ, spontaneous

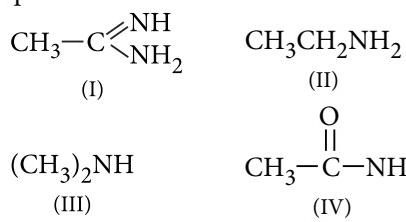
**31.** The vapour pressure of benzene at a certain temperature is 640 mm of Hg. A non-volatile and non-electrolyte solid weighing 2.175 g is added to 39.08 g of benzene. The vapour pressure of the solution is 600 mm of Hg. What is the molecular weight of solid substance?

- (a) 59.5 g mol $^{-1}$     (b) 69.5 g mol $^{-1}$   
 (c) 79.6 g mol $^{-1}$     (d) 79.9 g mol $^{-1}$

**32.** The two isomers X and Y with the formula  $Cr(H_2O)_5ClBr_2$  were taken for experiment on depression in freezing point. It was found that one mole of X gave depression corresponding to 2 moles of particles and one mole of Y gave depression due to 3 moles of particles. The structural formulae of X and Y respectively are

- (a)  $[Cr(H_2O)_5Cl]Br_2$ ;  $[Cr(H_2O)_4Br_2]Cl \cdot H_2O$   
 (b)  $[Cr(H_2O)_5Cl]Br_2$ ;  $[Cr(H_2O)_3ClBr_2] \cdot 2 H_2O$   
 (c)  $[Cr(H_2O)_5Br]ClBr$ ;  $[Cr(H_2O)_4ClBr]Br \cdot H_2O$   
 (d)  $[Cr(H_2O)_4Br_2]Cl \cdot H_2O$ ;  $[Cr(H_2O)_5Cl]Br_2$

**33.** The correct order of basicities of the following compounds is



- (a) II > I > III > IV    (b) I > III > II > IV  
 (c) III > I > II > IV    (d) I > II > III > IV

**34.** In complex hydrides, hydride ions act as ligand and are coordinated to metal ions. These hydrides are good reducing agents. Which of the following hydrides is not a complex hydride?

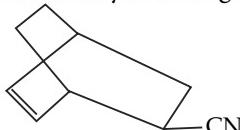
- (a)  $LiAlH_4$     (b)  $NaBH_4$   
 (c)  $(AlH_3)_n$     (d)  $LiBH_4$

**35.** Match the column I with column II and mark the appropriate choice.

Column I (Property)		Column II (Metal)	
(A)	Element with highest second ionisation enthalpy	(i)	Cr
(B)	Element with highest third ionisation enthalpy	(ii)	Cu
(C)	$M$ in $M(CO)_6$ is	(iii)	Zn
(D)	Element with highest heat of atomisation	(iv)	Ni

- (a) (A)  $\rightarrow$  (ii), (B)  $\rightarrow$  (iii), (C)  $\rightarrow$  (i), (D)  $\rightarrow$  (iv)  
 (b) (A)  $\rightarrow$  (iv), (B)  $\rightarrow$  (iii), (C)  $\rightarrow$  (i), (D)  $\rightarrow$  (ii)  
 (c) (A)  $\rightarrow$  (iii), (B)  $\rightarrow$  (i), (C)  $\rightarrow$  (ii), (D)  $\rightarrow$  (iv)  
 (d) (A)  $\rightarrow$  (i), (B)  $\rightarrow$  (ii), (C)  $\rightarrow$  (iii), (D)  $\rightarrow$  (iv)

36. The Diels—Alder reaction between 1,3-cyclohexadiene and acrylonitrile gives the adduct,



Its IUPAC name is

- (a) bicyclo [2.2.2] oct-2-en-5-nitrile  
 (b) bicyclo [2.2.2] oct-5-en-2-carbonitrile  
 (c) 3-cyano bicyclo [2.2.2] oct-5-ene  
 (d) 2-cyano bicyclo [2.2.2] oct-5-ene.

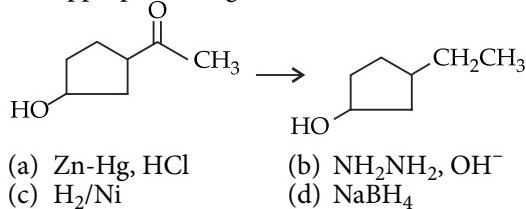
37. Give the decreasing order of reactivities of the following monomers towards cationic addition polymerisation.

- I.  $\text{MeCH=CH}_2$       II.  $\text{PhCH=CH}_2$   
 III.  $\text{CH}_2=\text{CH-COOMe}$    IV.  $\text{CH}_2=\text{CH-Cl}$   
 (a) I > II > III > IV      (b) II > I > IV > III  
 (c) II > I > III > IV      (d) I > II > IV > III

38. For which of the following amino acids, van-Slyke estimation method is not applicable?

- (a) Alanine      (b) Aspartic acid  
 (c) Serine      (d) Proline

39. The appropriate reagent for the transformation

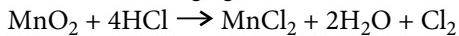


- (a) Zn-Hg, HCl      (b)  $\text{NH}_2\text{NH}_2, \text{OH}^-$   
 (c)  $\text{H}_2/\text{Ni}$       (d)  $\text{NaBH}_4$
40. Which of the following sets of reactants is used for the preparation of paracetamol from phenol?

- (a)  $\text{HNO}_3, \text{H}_2/\text{Pd}, (\text{CH}_3\text{CO})_2\text{O}$   
 (b)  $\text{H}_2\text{SO}_4, \text{H}_2/\text{Pd}, (\text{CH}_3\text{CO})_2\text{O}$   
 (c)  $\text{C}_6\text{H}_5\text{N}_2\text{Cl}, \text{SnCl}_2/\text{HCl}, (\text{CH}_3\text{CO})_2\text{O}$   
 (d)  $\text{Br}_2/\text{H}_2\text{O}, \text{Zn}/\text{HCl}, (\text{CH}_3\text{CO})_2\text{O}$

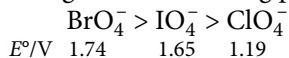
### SOLUTIONS

1. (c): HCl is oxidised by strong oxidising agents like manganese dioxide, lead dioxide, potassium permanganate, potassium dichromate, etc. hence, acts as a reducing agent.

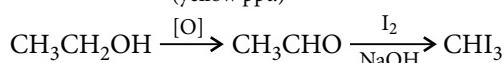
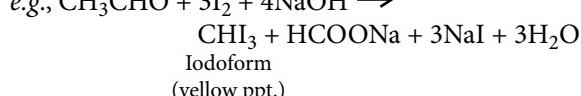


2. (c): Higher the reduction potential value of a

species, greater is its tendency to undergo reduction and stronger is the oxidising power.



3. (a): Iodoform test is given by the compounds containing  $\text{CH}_3\text{CO}-$  group or  $\text{CH}_3\text{CH(OH)}-$  group (which is oxidised to  $\text{CH}_3\text{CO}-$  group). Sample is heated with  $\text{I}_2$  and  $\text{NaOH}$ , the existence of yellow ppt. indicates the presence of  $\text{CH}_3\text{CO}-$  group or  $\text{CH}_3\text{CH(OH)}-$  group.  
 e.g.,  $\text{CH}_3\text{CHO} + 3\text{I}_2 + 4\text{NaOH} \rightarrow$



$\therefore$  *n*-Butyl alcohol ( $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ ) does not give iodoform test as it does not possess the  $\text{CH}_3\text{CO}-$  or  $\text{CH}_3\text{CH(OH)}-$  group.

4. (d):  $E \propto \frac{1}{n^2}$  i.e., when  $n = 3$ ;  $E$  decreases nine times.

5. (c): According to Hardy—Schulze rule, the flocculation power is directly proportional to the charge. Thus, correct order is :



6. (b): Stability of a complex depends upon the value of stability constant. Higher the value of  $K$ , more stable is the complex. Since,  $K$  is highest when  $\log K$  is 27.3.

Thus,  $[\text{Cu}(\text{CN})_4]^{2-}$  is the most stable complex among the given complexes.

7. (a): Acidity decreases as the electronegativity of the central halogen decreases from Cl to I in  $\text{HXO}$  (oxoacids).

8. (d)

9. (b): Mass of oxygen in the oxide

$$= (1.020 - 0.540) = 0.480 \text{ g}$$

$$\text{Equivalent mass of the metal} = \frac{0.540}{0.480} \times 8 = 9.0$$

According to Dulong and Petit's law,

$$\text{Approx. atomic mass} = \frac{6.4}{\text{sp. heat}} = \frac{6.4}{0.216} = 29.63$$

$$\text{Valency of the metal} = \frac{\text{at. mass}}{\text{eq. mass}} = \frac{29.63}{9.0} \approx 3$$

Hence, the formula of the oxide is  $M_2\text{O}_3$ .

10. (d): In this conformer Cl is at equatorial position and is least hindered.

**11. (a) :** When  $\Delta G_{sys} = 0$ , the system is in equilibrium.

$$12. (d): E_{cell} = E_{cell}^{\circ} - \frac{RT}{nF} \ln \frac{[Zn^{2+}]}{[Cu^{2+}]}$$

For I,  $\frac{[Zn^{2+}]}{[Cu^{2+}]} = 1, \therefore E_{cell} = E_{cell}^{\circ}$

For II,  $\frac{[Zn^{2+}]}{[Cu^{2+}]} = \frac{0.1}{1}$

$$\therefore E_{cell} = E_{cell}^{\circ} - \frac{0.0591}{n} \log 10^{-1} = E_{cell}^{\circ} + \frac{0.0591}{n}$$

For III,  $\frac{[Zn^{2+}]}{[Cu^{2+}]} = \frac{1}{0.1} = 10$

$$\therefore E_{cell} = E_{cell}^{\circ} - \frac{0.0591}{n} \log 10 = E_{cell}^{\circ} - \frac{0.0591}{n}$$

$$\therefore E_2 > E_1 > E_3$$

$$13. (b): \text{Number of moles of } O_2 = \frac{w}{M} = \frac{400 \times 10^{-3}}{32} = 0.0125$$

$$\text{Number of moles of } H_2 = \frac{w}{M} = \frac{60 \times 10^{-3}}{2} = 0.03$$

$$\text{From, } pV = nRT,$$

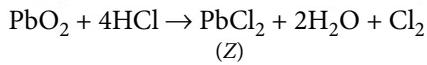
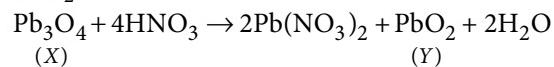
$$\text{Partial pressure of } O_2 = \frac{0.0125 \times 0.0821 \times 373}{1500 \times 10^{-3}} = 0.255 \text{ atm}$$

$$\text{Partial pressure of } H_2 = \frac{0.03 \times 0.0821 \times 373}{1500 \times 10^{-3}} = 0.612 \text{ atm}$$

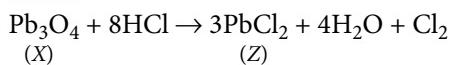
$$\text{Total pressure} = 0.255 + 0.612 = 0.867 \text{ atm}$$

**14. (a) :** Ionic radius of  $Fe^{3+}$  (0.64 Å) is less than that of  $Mn^{3+}$  (0.66 Å). Other properties vary as indicated.

**15. (a) :** Compound X, Y and Z are  $Pb_3O_4$ ,  $PbO_2$  and  $PbCl_2$ .

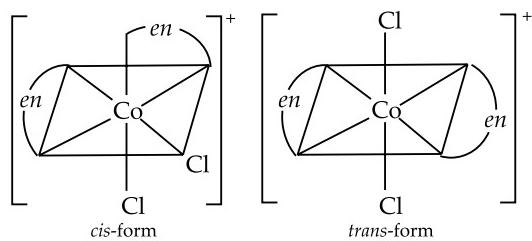


$PbCl_2$  is insoluble in cold water but soluble in hot water.

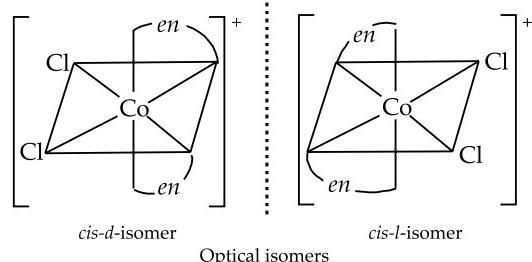


**16. (c) :** Ionisation isomerism arises when the coordination compounds give different ions in solution, this condition is not satisfied with  $[Co(en)_2Cl_2]Cl$ .

It is an octahedral complex.

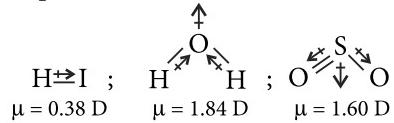


Geometrical isomers



Optical isomers

**17. (c) :**  $CO_2$  being symmetrical has zero dipole moment. Among  $HI$ ,  $SO_2$  and  $H_2O$ , dipole moment is highest for  $H_2O$  as the central atom in it contains 2 lone pairs.



**18. (d) :** For  $HIn \rightleftharpoons H^+ + In^-$

$$K_a = \frac{[H^+][In^-]}{[HIn]}$$

$$\therefore pH = pK_a + \log \frac{[In^-]}{[HIn]}$$

$$\text{or } pH - pK_a = \log \frac{[In^-]}{[HIn]}$$

**19. (a) :** The electronic configuration of Rb is  $[Kr] 5s^1$ . Thus, its valence electron enters in  $5s$ -orbital.

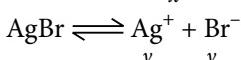
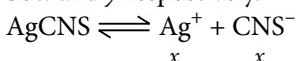
For  $5s$  orbital,  $n = 5$

$l = 0$  (as orbital is  $s$ )

$$m = -l \text{ to } +l \text{ including zero, } m = 0 ; s = +\frac{1}{2}$$

Thus, the correct set of quantum numbers for the valence electron of rubidium is  $5, 0, 0, +\frac{1}{2}$

**20. (a) :** Let the solubility of  $AgCNS$  and  $AgBr$  in water be  $x$  and  $y$  respectively.



$$\therefore [Ag^+] = (x+y), [CNS^-] = x, [Br^-] = y$$

$$K_{sp}[AgCNS] = [Ag^+][CNS^-] = x(x+y)$$

$$\Rightarrow 1 \times 10^{-12} = x(x + y) \quad \dots(i)$$

$$\text{and } K_{sp[\text{AgBr}]} = [\text{Ag}^+][\text{Br}^-] = y(x + y)$$

$$\Rightarrow 5 \times 10^{-13} = y(x + y) \quad \dots(ii)$$

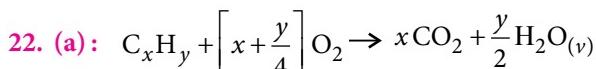
On solving Eq. (i) and (ii), we get

$$x = 8.16 \times 10^{-7} \text{ mol/L}$$

$$y = 4.08 \times 10^{-7} \text{ mol/L}$$



Here  $\text{SO}_2$  acts as an oxidising agent and thus oxidises  $\text{H}_2\text{S}(-2)$  to  $\text{S}(0)$ .



Initial vol.	500 mL	0	0
After reaction is complete	0	$500x$ mL	$\frac{y}{2} \times 500$ mL

$$\text{Now, } 500x = 2500$$

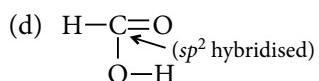
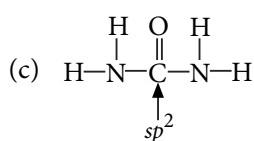
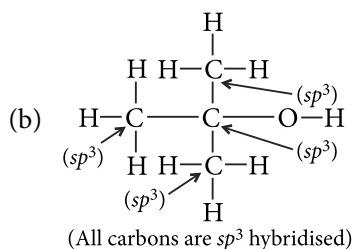
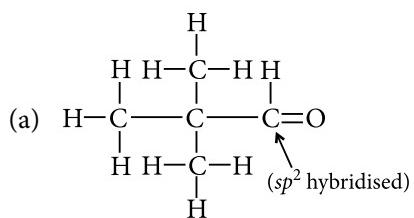
$$\therefore x = 5$$

$$\frac{500y}{2} = 3000$$

$$\therefore y = 12$$

Thus, the formula of alkane is  $\text{C}_5\text{H}_{12}$ .

**23. (b):** The complete structures of the given compounds are as follows :



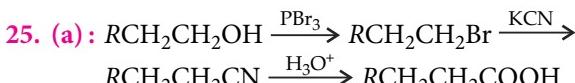
Thus,  $(\text{CH}_3)_3\text{C}-\text{OH}$  uses only its  $sp^3$ -hybrid orbitals for bond formation.

... (i)

... (ii)

**24. (d):** Compound  has  $8 + 2 = 10\pi$ -electrons, hence it is aromatic.

 has  $4\pi e^-$  and  has  $8\pi e^-$  then, these are antiaromatic compounds while  has  $8 + 1 = 9\pi e^-$ , hence, it is non-aromatic.



**26. (b):** London or photochemical smog are the mixture of smoke and fog. London smog is formed in cool humid climate when carbon soot particles combine with gaseous oxides of sulphur. Since in this type of smog, carbon and  $\text{SO}_2$  are present, it is reducing in nature. Photochemical smog, on the other hand occurs in warm, dry and sunny climate. It results in the formation of PAN. Since in photochemical smog,  $\text{O}_3$  is present, it irritates the eyes, nose, lungs, etc.

**27. (b):** Number of atoms present in the unit cell

$$(Z) = \frac{d \times a^3 \times N_A}{M}$$

$$\text{Given, } M = 2.7 \times 10^{-2} \text{ kg mol}^{-1}$$

$$a = 405 \text{ pm} = 405 \times 10^{-12} \text{ m} = 4.05 \times 10^{-10} \text{ m}$$

$$d = 2.7 \times 10^3 \text{ kg m}^{-3}$$

$$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$$

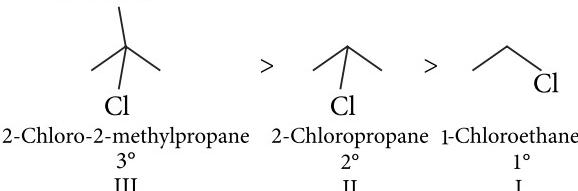
Hence,

$$Z = \frac{(2.7 \times 10^3 \text{ kg m}^{-3})(4.05 \times 10^{-10} \text{ m})^3 \times (6.022 \times 10^{23} \text{ mol}^{-1})}{(2.7 \times 10^{-2} \text{ kg mol}^{-1})} = 4$$

Since, there are four atoms per unit cell, the cubic unit cell must be face-centred.

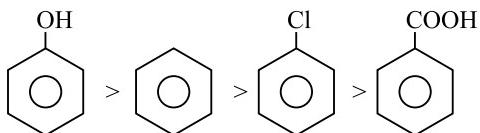
**28. (a):** Dehydrohalogenation reaction is also called  $\beta$ -elimination reaction and the reactivity of haloalkanes towards elimination reaction is:

$$3^\circ > 2^\circ > 1^\circ$$



**29. (b):** In general, electron releasing groups activate and electron withdrawing groups deactivate the benzene ring towards electrophilic substitution.

Hence, the correct order is :



- 30. (a):**  $2K_{(g)} + L_{(g)} \rightarrow 2M_{(g)}$
- $$\Delta n_g = 2 - 3 = -1$$
- $$\Delta H = \Delta U + \Delta n_g RT$$
- $$= -10.5 \times 10^3 + (-1 \times 8.314 \times 298)$$
- $$= -10500 + (-2477.572) = -12977.57 \text{ J} = -12.98 \text{ kJ}$$
- $$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$
- $$= -12.98 - 298 (-44.1 \times 10^{-3})$$
- $$= -12.98 + 13.14 = 0.16 \text{ kJ}$$

Since  $\Delta G^\circ$  is +ve hence it is a non-spontaneous reaction.

**31. (b):** 
$$\frac{P^\circ - P_s}{P^\circ} = \frac{\frac{w}{m}}{\frac{w}{m} + \frac{W}{M}}$$

w/m can be neglected in the denominator as compared to W/M.

$$\frac{w}{m} \times \frac{M}{W} = \frac{640 - 600}{640}$$

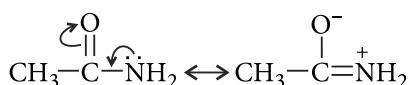
$$\frac{w}{m} \times \frac{M}{W} = \frac{40}{640} \Rightarrow \frac{2.175 \times 78}{m \times 39.08} = \frac{40}{640}$$

$$m = \frac{2.175 \times 78}{39.08} \times \frac{640}{40} = 69.46 \text{ g mol}^{-1}$$

- 32. (d):** The structural formula of the complex X is  $[\text{Cr}(\text{H}_2\text{O})_4\text{Br}_2]\text{Cl}\cdot\text{H}_2\text{O}$ , one mole of which gives 2 moles of particles, i.e.,  $[\text{Cr}(\text{H}_2\text{O})_4\text{Br}_2]^{+} + \text{Cl}^{-}$  and the formula of the complex Y is  $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]\text{Br}_2$ , one mole of which gives 3 moles of particles, i.e.,  $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]^{2+} + 2\text{Br}^{-}$ .

- 33. (b):** In  $\text{CH}_3-\overset{\text{NH}}{\underset{\text{NH}_2}{\text{C}}}=\text{NH}_2$ , lone pair on  $-\text{NH}_2$  remains more available for donation and its conjugate acid is resonance stabilised thus, it is most basic. Between  $\text{CH}_3\text{CH}_2\text{NH}_2$  and  $(\text{CH}_3)_2\text{NH}$ , the later is more basic because of the presence of two alkyl groups which facilitate the donation of lone pair of electrons.

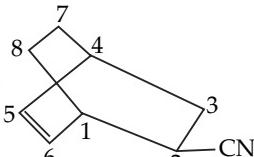
$\text{CH}_3-\overset{\text{O}}{\underset{\text{NH}_2}{\text{C}}}=\text{NH}_2$  is least basic as the lone pair of N is involved in resonance.



Thus, the correct order of basicity is I > III > II > IV.

- 34. (c):**  $(\text{AlH}_3)_n$  is a polymeric hydride like  $(\text{BeH}_2)_n$ ,  $(\text{MgH}_2)_n$ , etc.

- 35. (a)**

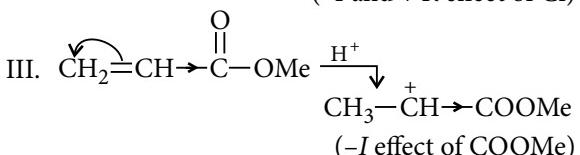
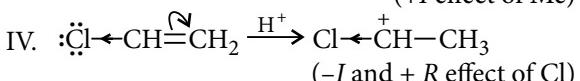
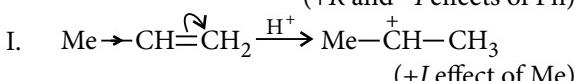
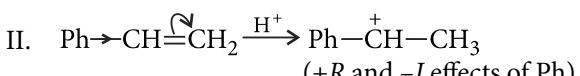


- 36. (b):**

Bicyclo [2.2.2] oct-5-en-2-carbonitrile

- 37. (b):** Cationic polymerisation is favoured by the presence of electron donating group (e.g., Me group). The more the electron donating group, the more stable is the intermediate carbocation, and as a result more favoured is the cationic polymerisation.

Stability of  $(\text{C}^+)$  is

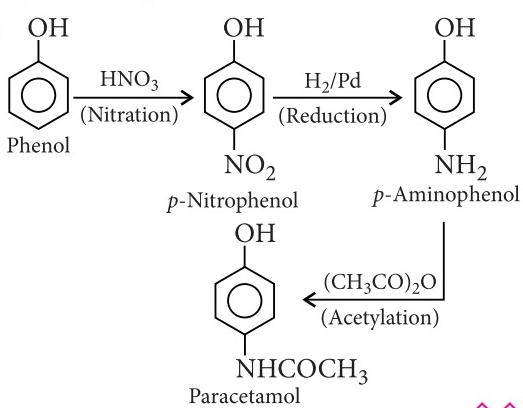


The decreasing reactivity order towards cation polymerisation is (II) > (I) > (IV) > (III).

- 38. (d):** Proline has a 2° amino group. Hence, it is not estimated by this method.

- 39. (b):**  $-\text{COCH}_3$  group can be reduced to  $-\text{CH}_2\text{CH}_3$  by either Zn-Hg, HCl or  $\text{NH}_2\text{NH}_2$ ,  $\text{OH}^-$  but with Zn-Hg, HCl, dehydration of alcohol takes place.

- 40. (a):**





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MAY**

PAPER-I

## **SECTION 1 (Maximum Marks : 15)**

- This section contains **FIVE** questions.
  - Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
  - For each question, darken the bubble corresponding to the correct option in the ORS.
  - For each question, marks will be awarded in one of the following categories :

**Full Marks : +3 If only the bubble corresponding to the correct option is darkened.**

**Zero Marks : 0** If none of the bubbles is darkened.

**Negative Marks : -1** In all other cases

1. What transition in the hydrogen spectrum would have the same wavelength as the Balmer transition  $n = 4$  to  $n = 2$  of  $\text{He}^+$  spectrum?

(a)  $n_1 = 1$  to  $n_2 = 2$       (b)  $n_1 = 2$  to  $n_2 = 4$   
(c)  $n_1 = 1$  to  $n_2 = 3$       (d)  $n_1 = 2$  to  $n_2 = 3$



3. In  $[\text{Ni}(\text{CN})_4]^{2-}$ ,  $[\text{MnBr}_4]^{2-}$  and  $[\text{CoF}_6]^{3-}$  ions, the geometry, hybridisation and magnetic moment, respectively are

  - (a) tetrahedral, square planar, octahedral ;  
 $sp^3, dsp^2, sp^3 d^2$  ; 5.9, 0, 4.9
  - (b) tetrahedral, square planar, octahedral ;  
 $dsp^2, sp^3, sp^3 d^2$  ; 0, 5.9, 4.9
  - (c) square planar, tetrahedral, octahedral ;  
 $dsp^2, sp^3, d^2 sp^3$  ; 5.9, 4.9, 0
  - (d) square planar, tetrahedral, octahedral ;  
 $dsp^2, sp^3, sp^3 d^2$  ; 0, 5.9, 4.9

- 4.** In which of the following arrangements, the order is not according to the property indicated against it?

  - (a)  $\text{Al}^{3+} < \text{Mg}^{2+} < \text{Na}^+ < \text{F}^-$  (increasing ionic size)
  - (b)  $\text{B} < \text{C} < \text{N} < \text{O}$   
(increasing first ionisation enthalpy)
  - (c)  $\text{I} < \text{Br} < \text{F} < \text{Cl}$  (increasing electron gain enthalpy with negative sign)
  - (d)  $\text{Li} < \text{Na} < \text{K} < \text{Rb}$  (increasing metallic radius)

**5.** In a polymer sample, 30% of molecules have a molecular mass of 20,000, 40% have 30,000 and the rest 60,000. What is the weight average molecular mass of the polymer?

  - (a) 40,300
  - (b) 30,600
  - (c) 43.333
  - (d) 33.353

## **SECTION 2 (Maximum Marks : 32)**

- This section contains EIGHT questions.
  - Each question has FOUR options (A), (B), (C) and (D). ONE OR MORE THAN ONE of these four option(s) is(are) correct.
  - For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS.
  - For each question, marks will be awarded in one of the following categories :

**Full Marks : +4** If only the bubble(s) corresponding to the correct option(s) is(are) darkened.

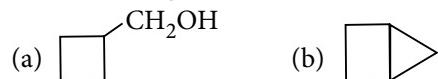
**Partial Marks :** +1 For darkening a bubble corresponding to each correct option, provided NO incorrect option is darkened.

**Zero Marks : 0** If none of the bubbles is darkened.

**Negative Marks : -2** In all other cases.

- For example, if (A), (C) and (D) are all the correct options for a question, darkening all these three will result in +4 marks; darkening only (A) and (D) will result in +2 marks; and darkening (A) and (B) will result in -2 marks, as a wrong option is also darkened.

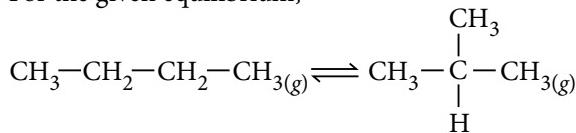
6. Treatment of cyclobutylmethylamine with nitrous acid does not give



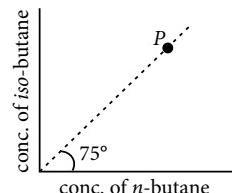




- 13.** For the given equilibrium;



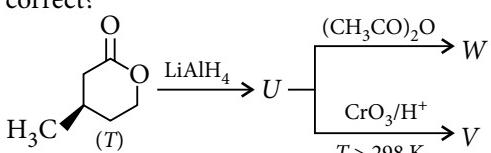
equilibrium constant is found to be 1.732 at 298 K. Now, if in a vessel at 298 K, a mixture of these two gases be taken as represented by the point *P* in the figure, predict what will happen?



- (a) Immediately above equilibrium will be setup.
  - (b) Above reaction will go in the forward direction till it attains equilibrium.
  - (c) Above reaction will go in the backward direction till it attains equilibrium.
  - (d) Nothing can be said.

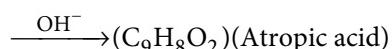
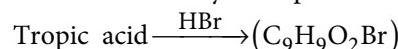
### **SECTION 3 (Maximum Marks : 15)**

- This section contains FIVE questions.
  - The answer to each question is a SINGLE DIGIT INTEGER ranging from 0 to 9, both inclusive.
  - For each question, darken the bubble corresponding to the correct integer in the ORS.
  - For each question, marks will be awarded in one of the following categories :  
**Full Marks :** +3 If only the bubble corresponding to the correct answer is darkened.  
**Zero Marks :** 0 In all other cases.



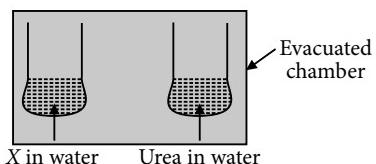
- (a)  $T$  is soluble in hot aqueous  $\text{NaOH}$ .  
 (b)  $U$  is optically active.  
 (c) Molecular formula of  $W$  is  $\text{C}_{10}\text{H}_{18}\text{O}_4$ .  
 (d)  $V$  gives effervescence on treatment with aqueous  $\text{NaHCO}_3$ .

14. Tropic acid (obtained from the alkaloid atropine),  $C_9H_{10}O_3$ , gives a positive  $CrO_3/H_2SO_4$  test at 273 K and is oxidised by hot  $KMnO_4$  to benzoic acid. Tropic acid is converted by the following sequence of reactions into hydratropic acid :



Number of carbon atoms in the ring in tropic acid is

15. Two aqueous solutions as shown, are put in an evacuated chamber. When equilibrium is attained, it is found that one solution contains 0.01% of X and other 0.02% of urea by weight. If the molecular weight of X is  $(n \times 10)$  amu, then what is n (X is non-electrolyte and non-volatile solute)?



16. Total number of geometrical isomers for the complex  $[\text{RhCl}(\text{CO})(\text{PPh}_3)(\text{NH}_3)]$  is

17. How many electrons are transferred when  $\text{KMnO}_4$  acts as oxidising agent to give  $\text{Mn}(\text{OH})_3$ ?

18. The compressibility factor for 1 mole of a van der Waals gas at  $0^\circ\text{C}$  and 100 atm pressure is found to be 0.5. Assuming that the volume of a gas molecule is negligible, the van der Waals constant,  $a$  is  $x \cdot 25$ . The value of  $x$  is

## PAPER-II

### SECTION 1 (Maximum Marks : 18)

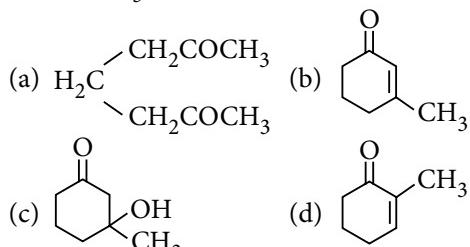
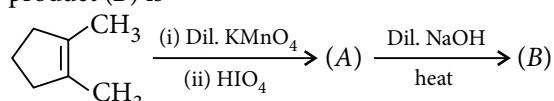
- This section contains SIX questions.
- Each question has FOUR options (A), (B), (C) and (D). ONLY ONE of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :

**Full Marks :** +3 If only the bubble corresponding to the correct option is darkened.

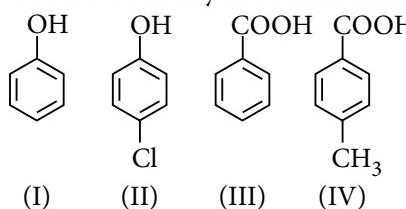
**Zero Marks :** 0 If none of the bubbles is darkened.

**Negative Marks :** -1 In all other cases.

1. In the following sequence of reactions, the final product (B) is

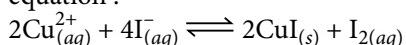


2. The correct acidity order of the following is

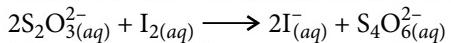


- (a) III > IV > II > I      (b) IV > III > I > II  
 (c) III > II > I > IV      (d) II > III > IV > I

3. The percentage of copper in a copper(II) salt can be determined by using a thiosulphate titration. 0.305 g of a copper(II) salt was dissolved in water and added to an excess of potassium iodide solution liberating iodine according to the following equation :



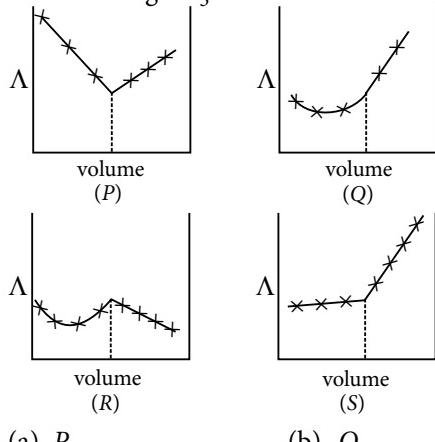
The iodine liberated required  $24.5 \text{ cm}^3$  of a  $0.100 \text{ mole dm}^{-3}$  solution of sodium thiosulphate.



The percentage of copper, by mass in the copper(II) salt is [Atomic mass of copper = 63.5]

- (a) 64.2      (b) 51.0  
 (c) 48.4      (d) 25.5

4.  $\text{AgNO}_3_{(aq)}$  was added to an aqueous  $\text{KCl}$  solution gradually and the conductivity of the solution was measured. The plot of conductance ( $\Lambda$ ) versus the volume of  $\text{AgNO}_3$  is



- (a) P      (b) Q  
 (c) R      (d) S

5. A red solid is insoluble in water. However, it becomes soluble if some KI is added to water. Heating the red solid in a test tube results in liberation of some violet coloured fumes and droplets of a metal appear on the cooler part of the test tube. The red solid is

- (a)  $\text{HgI}_2$       (b)  $\text{HgO}$   
 (c)  $\text{Pb}_3\text{O}_4$       (d)  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$

6. Zinc granules are added in excess to 500 mL of 1 M nickel nitrate solution at  $25^\circ\text{C}$  until the equilibrium is reached. If the standard reduction potentials of  $\text{Zn}^{2+}|\text{Zn}$  and  $\text{Ni}^{2+}|\text{Ni}$  are  $-0.75 \text{ V}$  and  $-0.24 \text{ V}$  respectively. The concentration of  $\text{Ni}^{2+}$  in solution at equilibrium is

- (a)  $0.05 \times 10^{-8}$  M      (b)  $5.5 \times 10^{-18}$  M  
 (c)  $55 \times 10^{-8}$  M      (d)  $0.75 \times 10^{-8}$  M

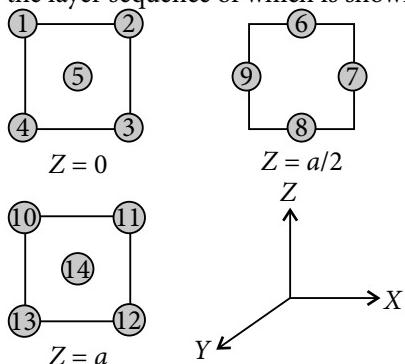
### SECTION 2 (Maximum Marks : 32)

- This section contains EIGHT questions.
  - Each question has FOUR options (A), (B), (C) and (D). ONE OR MORE THAN ONE of these four option(s) is(are) correct.
  - For each question, darken the bubble(s) corresponding to all the correct option(s) in the ORS.
  - For each question, marks will be awarded in one of the following categories :
- Full Marks : +4** If only the bubble(s) corresponding to all the correct option(s) is(are) darkened.
- Partial Marks : +1** For darkening a bubble corresponding to each correct option, provided NO incorrect option is darkened.
- Zero Marks : 0** If none of the bubbles is darkened.
- Negative Marks : -2** In all other cases.
- For example, if (A), (C) and (D) are all the correct options for a question, darkening all these three will result in +4 marks; darkening only (A) and (D) will result in +2 marks; and darkening (A) and (B) will result in -2 marks, as a wrong option is also darkened.

7. Which of the following species have the same shape and same bond order?

- |                    |                      |
|--------------------|----------------------|
| (i) $\text{CO}_2$  | (ii) $\text{N}_3^-$  |
| (iii) $\text{O}_3$ | (iv) $\text{NO}_2^-$ |
| (a) (i) and (ii)   | (b) (iii) and (iv)   |
| (c) (i) and (iii)  | (d) (ii) and (iv)    |

8. A metal has cubic close packing (ccp) arrangement, the layer sequence of which is shown as :



A face diagonal passes through the centre of atom 4 and the centre(s) of which other atom(s)?

- |           |           |
|-----------|-----------|
| (a) 1     | (b) 2, 5  |
| (c) 8, 12 | (d) 9, 10 |

9. Consider the following compounds :



Pyrrole (I)



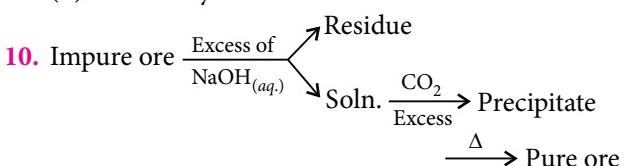
Pyridine (II)



Aniline (III)

Which of the following statement(s) is/are correct?  
 (a) I is more basic than II.

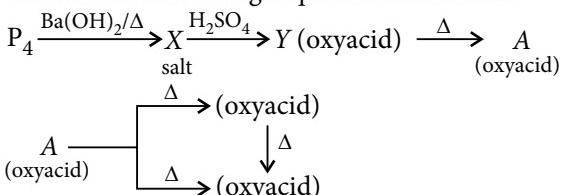
- (b) II is more basic than I and III.  
 (c) III is more basic than II.  
 (d) I is weakly acidic.



Above method is applicable for

- |                 |               |
|-----------------|---------------|
| (a) red bauxite | (b) haematite |
| (c) galena      | (d) cuprite.  |

11. Consider the following sequence of reactions :



In the above sequence of reactions Y and A are respectively

- |   |  |
|---|--|
| (a) $\text{H}_3\text{PO}_2$ and $\text{H}_3\text{PO}_4$ | (b) $\text{H}_3\text{PO}_4$ and $\text{H}_4\text{P}_2\text{O}_7$ |
| (c) $\text{H}_3\text{PO}_4$ and $\text{HPO}_3$          | (d) $\text{H}_3\text{PO}_3$ and $\text{H}_3\text{PO}_4$          |

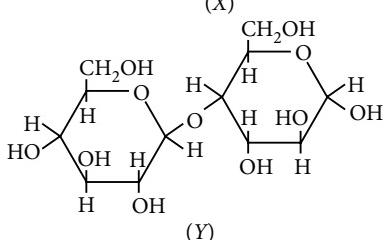
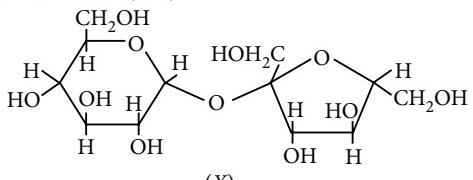
12. Consider the following solutions :

- |  |
|--|
| (i) $\text{C}_6\text{H}_{12}\text{O}_6/\text{H}_2\text{O}$ (1 M)   |
| (ii) $\text{NaCl}/\text{H}_2\text{O}$ (1 M)                        |
| (iii) $\text{C}_6\text{H}_5\text{COOH}/\text{C}_6\text{H}_6$ (1 M) |
| (iv) $(\text{NH}_4)_3\text{PO}_4/\text{H}_2\text{O}$ (1 M)         |

With respect to these solutions select the correct statement(s).

- |  |
|--|
| (a) All are isotonic solutions.                |
| (b) (iii) is hypotonic of (ii) and (iv).       |
| (c) (ii) and (iv) are hypertonic of (i).       |
| (d) (iv) is hypertonic of (i), (ii) and (iii). |

13. The correct statement(s) about the following sugars X and Y is (are)

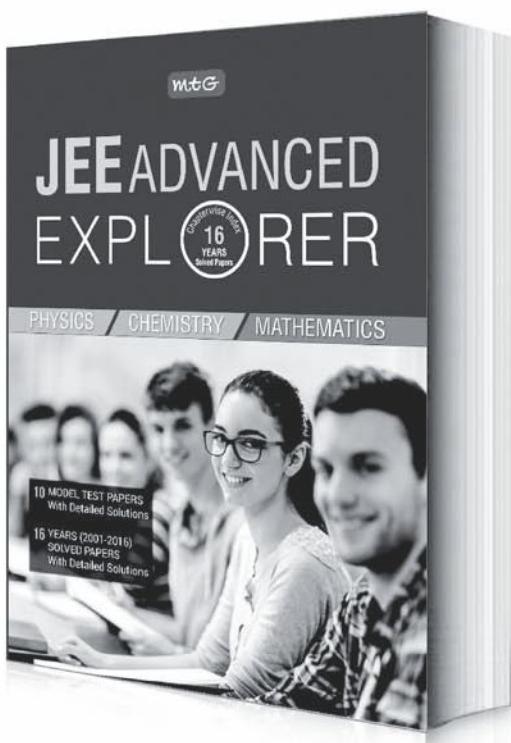


- |   |
|---|
| (a) X is a reducing sugar and Y is a non-reducing sugar |
|---|

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- (b)  $X$  is a non-reducing sugar and  $Y$  is a reducing sugar  
 (c) the glycosidic linkages in  $X$  and  $Y$  are  $\alpha$  and  $\beta$ , respectively  
 (d) the glycosidic linkages in  $X$  and  $Y$  are  $\beta$  and  $\alpha$ , respectively.
- 14.** 4, 4'-Dinitrodiphenyl is obtained when  
 (a) 4-nitrochlorobenzene is heated with Na/ether  
 (b) 4-nitroiodobenzene is heated with copper powder in a sealed tube  
 (c) diphenyl is heated with a mixture of conc.  $HNO_3 + \text{conc. } H_2SO_4$   
 (d) nitrobenzene is treated with 4-nitrochlorobenzene in presence of anhyd.  $AlCl_3$ .

### SECTION 3 (Maximum Marks : 12)

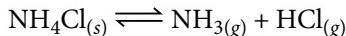
- This section contains TWO paragraphs.
- Based on each paragraph, there are TWO questions.
- Each question has FOUR options (A), (B), (C) and (D). ONLY ONE of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :

**Full Marks :** +3 If only the bubble corresponding to the correct option is darkened.

**Zero Marks :** 0 In all other cases.

#### PARAGRAPH 1

Decomposition of ammonium chloride is an endothermic reaction. The equilibrium may be represented as :



A 6.250 g sample of  $NH_4Cl$  is placed in an evacuated 4.0 L container at 27°C. After equilibrium the total pressure inside the container is 0.820 bar and some solid remains in the container.

- 15.** The value of  $K_p$  for the reaction at 300 K is  
 (a) 16.2 (b) 0.168  
 (c) 1.68 (d) 32.4
- 16.** The amount of solid  $NH_4Cl$  left behind in the container at equilibrium is  
 (a) 2.996 (b) 28.56  
 (c) 0.2856 (d) 1.320

#### PARAGRAPH 2

A mixture of two compounds  $A$  and  $B$  was separated by dissolving in chloroform followed by extraction with aqueous KOH solution. The organic layer containing compound  $A$ , when heated with alcoholic solution of KOH produced a compound  $C(C_7H_5N)$  associated with an unpleasant odour. The alkaline aqueous layer on the

other hand, when heated with chloroform and then acidified gave a mixture of two isomeric compounds  $D$  and  $E$  of molecular formula  $C_7H_6O_2$ .

- 17.** Compounds  $A$  and  $B$  respectively are  
 (a)  $C_6H_5OH, C_6H_5OCH_3$   
 (b)  $C_6H_5NH_2, C_6H_5OH$   
 (c)  $C_6H_5OH, C_6H_5NH_2$   
 (d)  $C_6H_5CH_2OH, C_6H_5CH_2NH_2$
- 18.** The compounds  $D$  and  $E$  respectively are  
 (a)  $C_6H_5CHO, o\text{-HO---}C_6H_4CHO$   
 (b)  $C_6H_5CHO, m\text{-HO---}C_6H_4CHO$   
 (c)  $C_6H_5CHO, p\text{-HO---}C_6H_4CHO$   
 (d)  $o\text{-HO---}C_6H_4CHO, p\text{-HO---}C_6H_4CHO$

### SOLUTIONS

#### PAPER-I

$$\begin{aligned} \text{1. (a)}: \bar{v}_H &= \frac{1}{\lambda_H} = R \left( \frac{1}{n_1^2} - \frac{1}{n_2^2} \right) && \dots(\text{i}) \\ \bar{v}_{He^+} &= \frac{1}{\lambda_{He^+}} = RZ^2 \left( \frac{1}{2^2} - \frac{1}{4^2} \right) \\ &= R \times 4 \left( \frac{1}{4} - \frac{1}{16} \right) = R \times \left( \frac{4}{4} - \frac{4}{16} \right) \\ &= R \times \left( 1 - \frac{1}{4} \right) && \dots(\text{ii}) \end{aligned}$$

Comparing equations (i) and (ii), we get  
 $\therefore \Rightarrow n_1 = 1$  and  $n_2 = 2$

- 2. (c)**: Suppose  $n$  moles of gas are present.

$$\begin{aligned} \therefore n &= \frac{PV}{RT} = \frac{1.6 \times 10^6 \times 0.0083}{8.3 \times 300} = 5.33 \\ C_v &= \frac{5}{2}R - R = \frac{3}{2}R = \frac{3}{2} \times 8.3 = 12.45 \text{ J mol}^{-1} \text{ K}^{-1} \end{aligned}$$

$$\begin{aligned} \text{Heat supplied at constant volume } (q_v) &= n \times C_v \times \Delta T \\ 2.49 \times 10^4 &= 5.33 \times 12.45 \times \Delta T \end{aligned}$$

$$\Delta T = \frac{2.49 \times 10^4}{5.33 \times 12.45} \Rightarrow \Delta T \approx 375 \text{ K}$$

- 3. (d)**: In  $[Ni(CN)_4]^{2-}$ ,  $Ni^{2+} = 3d^8$ ,  $dsp^2$  hybridisation (square planar geometry), no unpaired electron is present and magnetic moment is zero.

In  $[MnBr_4]^{2-}$ ,  $Mn^{2+} = 3d^5$ ,  $sp^3$  hybridisation (tetrahedral geometry),  $n = 5$ ,

$$\mu = \sqrt{5(5+2)} \text{ B.M.} = \sqrt{35} \text{ B.M.} = 5.9 \text{ B.M.}$$

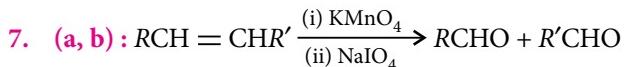
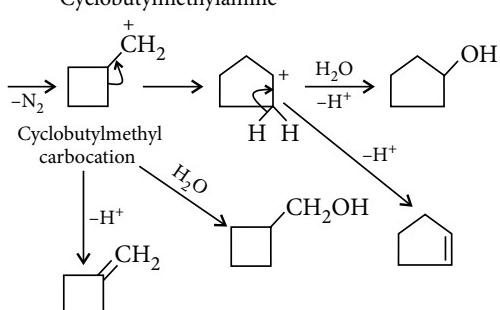
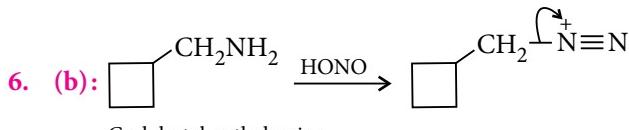
In  $[CoF_6]^{3-}$ ,  $Co^{3+} = 3d^6$ ,  $sp^3d^2$  hybridisation (octahedral geometry),

$$n = 4, \mu = \sqrt{4(4+2)} \text{ B.M.} = \sqrt{24} \text{ B.M.} = 4.9 \text{ B.M.}$$

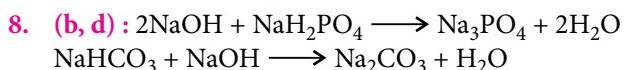
4. (b)

$$5. (c) : \bar{M}_w = \frac{\sum N_i M_i^2}{\sum N_i M_i}$$

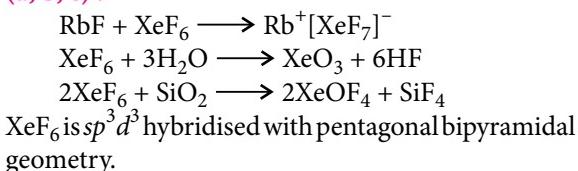
$$\bar{M}_w = \frac{30(20000)^2 + 40(30000)^2 + 30(60000)^2}{(30 \times 20000) + (40 \times 30000) + (30 \times 60000)} \\ = 43,333.33 \approx 43,333$$



A solution of  $NaIO_4$  containing a trace of  $KMnO_4$  is called Lemieux reagent.



9. (a, b, c) :



10. (a) : Let  $w$  g of each be taken.

$$\text{Initial mole of } P = \frac{w}{100}; \text{ Final mole of } P = \frac{w}{5 \times 100}$$

$$\text{Initial mole of } Q = \frac{w}{200}; \text{ Final mole of } Q = \frac{4w}{5 \times 200}$$

$$\text{For } P: \left(\frac{N_0}{N}\right)_P = e^{\lambda_1 t} \text{ or } \frac{w \times 5 \times 100}{100 \times w} = e^{\lambda_1 \times 20} \dots (i)$$

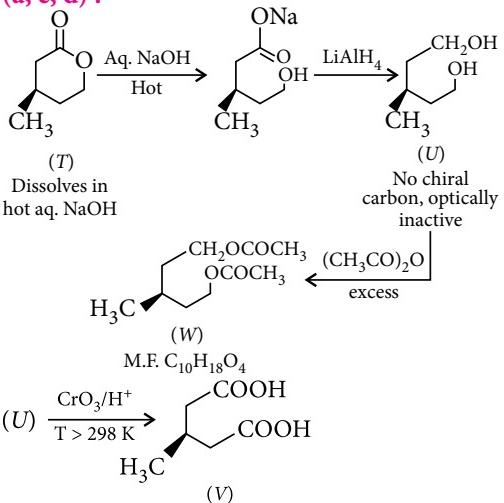
$$\text{For } Q: \left(\frac{N_0}{N}\right)_Q = e^{\lambda_2 t} \text{ or } \frac{w \times 5 \times 200}{200 \times w \times 4} = e^{\lambda_2 \times 20} \dots (ii)$$

By eqs. (i) and (ii),  $4 = e^{(\lambda_1 - \lambda_2) \times 20}$

$$\text{or } \lambda_1 - \lambda_2 = \frac{\log_e 4}{20}$$

$$\text{or } \frac{0.693}{10} - \frac{0.693}{t} = \frac{\log_e 4}{20} \Rightarrow t = \infty$$

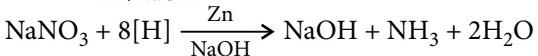
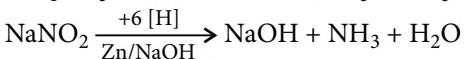
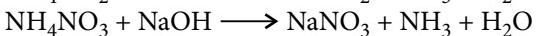
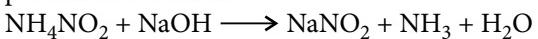
11. (a, c, d) :



(T) Dissolves in hot aq. NaOH  
(U) No chiral carbon, optically inactive

V gives effervescence with  $NaHCO_3$  due to evolution of  $CO_2$ .

12. (a, b) : All ammonium salts on reaction with alkali produce ammonia, but nitrates and nitrites salts produce ammonia along with nitrates and nitrites which on further reduction with Zn dust again produces ammonia.

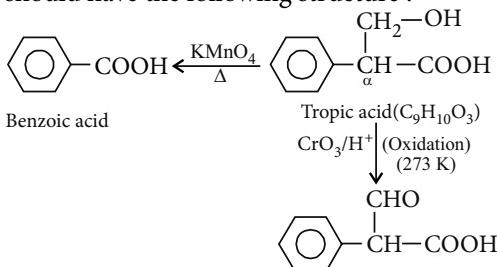


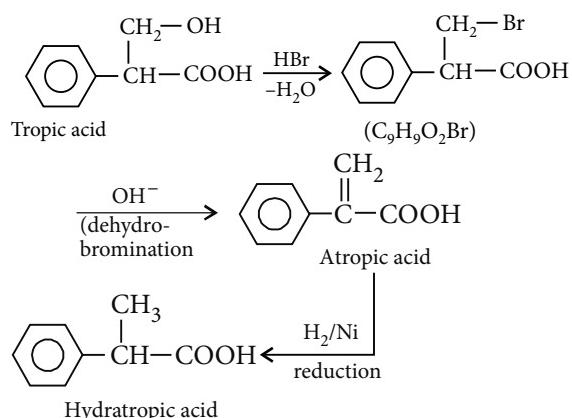
13. (c) :  $Q_c = \tan 75^\circ = 3.732 = \frac{\text{conc. of iso-butane}}{\text{conc. of } n\text{-butane}} > K_c$

As  $Q_c > K_c$ , thus backward reaction takes place till equilibrium is attained.

14. (6) : (a) Since tropic acid is oxidised by  $CrO_3/H_2SO_4$ , it suggests the presence of  $\text{CH}-OH$  or  $-\text{CH}_2-\text{OH}$  group in it.

(b) Tropic acid is also oxidised by hot alkaline  $KMnO_4$  into benzoic acid, indicating the presence of a benzene nucleus and atleast one  $\alpha$  H-atom in the side chain of tropic acid. Thus, tropic acid should have the following structure :

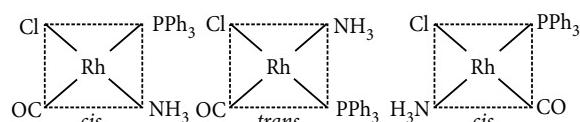




**15. (3):** At equilibrium, lowering in vapour pressure of both the solutions is same.

$$\text{Then, } \frac{0.01}{M_X} = \frac{0.02}{60} \Rightarrow M_X = 30 \text{ amu} \therefore n = 3$$

**16. (3):**  $[\text{RhCl}(\text{CO})(\text{PPh}_3)(\text{NH}_3)]$  is a square planar complex of the type  $MABCD$ . Hence, it has three geometrical isomers as follows :



17. (4)

$$18. (1): Z = \frac{PV}{RT}; \quad 0.5 = \frac{100 \times V}{0.0821 \times 273}; \quad V = 0.112 \text{ L}$$

Neglecting  $b$ , van der Waals equation reduces to

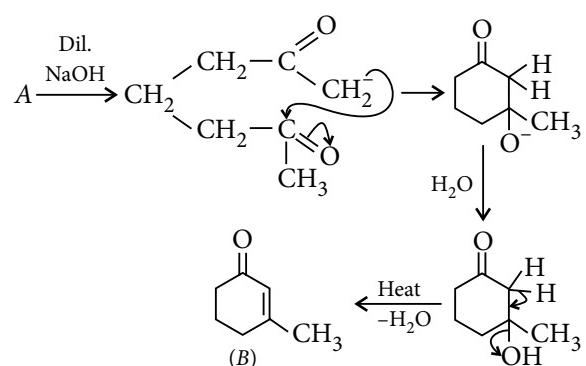
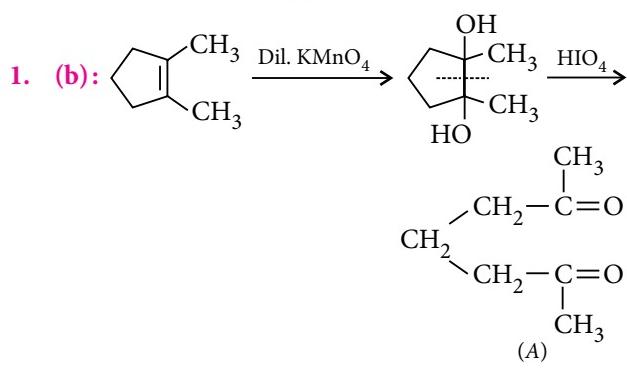
$$\left( P + \frac{a}{V^2} \right) V = RT \quad \text{or} \quad PV + \frac{a}{V} = RT$$

$$\text{or } 100 \times 0.112 + \frac{a}{0.112} = 0.0821 \times 273$$

$$a = 1.25 \text{ L}^2 \text{ atm mol}^{-2}$$

Comparing 1.25 with  $x.25$ , we get  $x = 1$

Paper-II



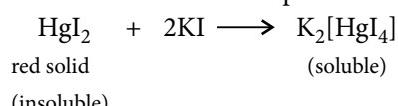
2. (a)

$$\begin{aligned} \text{3. (b): } \text{Millimoles of hypo} &\equiv \text{millimoles of iodine} \times 2 \\ &\equiv \text{millimoles of Cu}^{2+} \text{ ions} \\ &= 24.5 \times 0.1 \text{ millimoles} \\ \therefore \text{Mass of copper} &= 24.5 \times 0.1 \times 10^{-3} \times 63.5 \text{ g} \end{aligned}$$

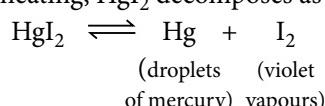
$$\text{So, \% of copper} = \frac{24.5 \times 0.1 \times 10^{-3} \times 63.5}{0.305} \times 100\% \\ = 51.0\%$$

4. (d):  $\text{AgNO}_3(aq) + \text{KCl}(aq) \longrightarrow \text{AgCl}_{(s)} + \text{KNO}_3(aq)$   
Conductivity of the solution is almost compensated due to formation of  $\text{KNO}_3(aq)$  as  $\text{Cl}^-$  and  $\text{NO}_3^-$  both have almost same ionic conductivity. However, after the end point, conductivity increases more rapidly due to addition of excess  $\text{AgNO}_3$  solution.

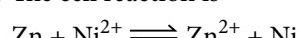
5. (a): When KI is added to mercuric iodide it dissolves in it and forms complex.



On heating,  $\text{HgI}_3$  decomposes as :



**6. (b):** The cell reaction is



$$E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{0.0591}{2} \log \frac{[\text{Zn}^{2+}]}{[\text{Ni}^{2+}]}$$

At equilibrium,  $E_{\text{cell}} = 0$

$$\therefore E_{\text{cell}}^{\circ} = \frac{0.0591}{2} \log \frac{[\text{Zn}^{2+}]}{[\text{Ni}^{2+}]}$$

$$E_{\text{Ni}^{2+}/\text{Ni}}^{\circ} - E_{\text{Zn}^{2+}/\text{Zn}}^{\circ} = \frac{0.0591}{2} \log \frac{[\text{Zn}^{2+}]}{[\text{Ni}^{2+}]}$$

$$-0.24 - (-0.75) = \frac{0.0591}{2} \log \frac{[\text{Zn}^{2+}]}{[\text{Ni}^{2+}]}$$

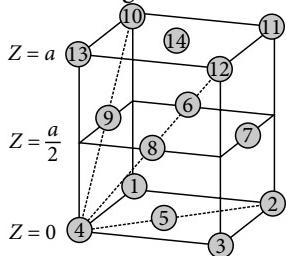
$$\therefore \frac{[\text{Zn}^{2+}]}{[\text{Ni}^{2+}]} = 1.816 \times 10^{17}$$

This concentration ratio shows that almost whole of the  $\text{Ni}^{2+}$  ions are reduced to Ni and therefore, the concentration of  $\text{Zn}^{2+}$  produced from Zn would be nearly 1 M [ $\because \text{Ni}(\text{NO}_3)_2 = 1 \text{ M}$ ]. Thus,

$$\frac{1}{[\text{Ni}^{2+}]} = 1.816 \times 10^{17} \Rightarrow [\text{Ni}^{2+}] = 5.5 \times 10^{-18} \text{ M}$$

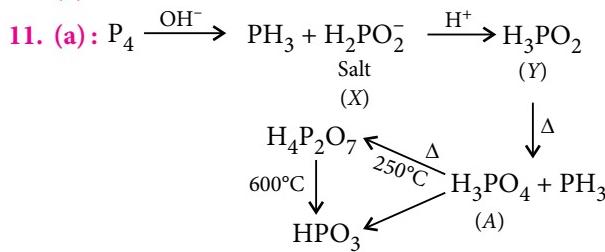
**7. (a, b)**:  $\text{CO}_2$  and  $\text{N}_3^-$  are linear with bond order 2.  $\text{O}_3$  and  $\text{NO}_2^-$  are V-shaped and bond order 1.5.

**8. (b, c, d)**:  $Z = 0$  forms the bottom layer,  $Z = a/2$  forms second layer above it and  $Z = a$  forms the third layer. Atoms 5, 6, 7, 8, 9 and 14 are present at the face centres. Atoms 1, 2, 3, 4, 10, 11, 12 and 13 are present at the corners. 4, 5, 2 form one face diagonal; 4, 9, 10 form another face diagonal; 4, 8, 12 form one more face diagonal.



**9. (b, d)**: Due to delocalisation of electrons of the N-atom over the benzene ring in aniline (III) and involvement of these electrons in aromatic sextet formation in pyrrole (I), both these amines are weaker bases than pyridine (II) in which such a delocalisation does not exist since the lone pair of electrons is present in a  $sp^2$ -hybridised orbital which lies outside the plane of the ring. Hence, II is more basic than I and III. Further, I is so much less basic that with strong bases, it behaves as a weak acid.

**10. (a)**



**12. (b, c, d)**    **13. (b, c)**    **14. (a, b, c)**

$$\text{15. (b)}: P_{\text{NH}_3} = P_{\text{HCl}} = \frac{0.820}{2} \text{ bar}$$

$$\therefore K_p = P_{\text{NH}_3} \times P_{\text{HCl}} = 0.41 \times 0.41 = 0.168$$

$$\text{16. (a)}: \text{Moles of gases, } n = \frac{PV}{RT} = \frac{0.820 \times 4}{0.083 \times 300} = 0.132 \text{ mol}$$

$$\text{Moles of NH}_3 = \text{Moles of HCl} = \frac{0.132}{2} = 0.066$$

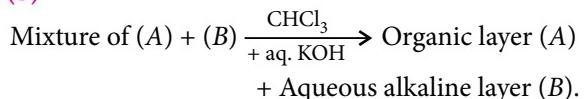
$$\text{Moles of NH}_4\text{Cl decomposed} = \text{Moles of NH}_3 = 0.066$$

$$\text{Moles of NH}_4\text{Cl initially present} = \frac{6.250}{53.5} = 0.117$$

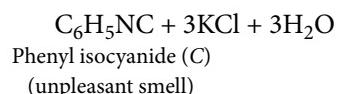
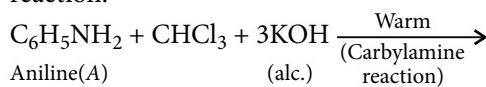
$$\text{Moles of NH}_4\text{Cl left} = 0.117 - 0.066 = 0.051$$

$$\text{Mass of NH}_4\text{Cl left behind} = 0.051 \times 53.5 = 2.73 \text{ g}$$

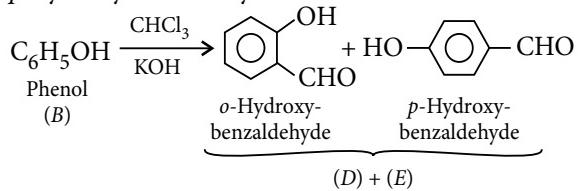
**17. (b)**



Since compound (A) does not dissolve in alkali, therefore, it may be an amine. Further, since on treatment with  $\text{CHCl}_3$  and alcoholic KOH, it produces  $\text{C}_6\text{H}_5\text{N}$  having unpleasant smell, therefore, (A) may be  $\text{C}_6\text{H}_5\text{NH}_2$  and (C) must be  $\text{C}_6\text{H}_5\text{NC}$  and the name of the reaction is carbylamine reaction.



Since aqueous alkaline layer (B) on heating with  $\text{CHCl}_3$  followed by acidification gives two isomeric compounds having molecular formula ( $\text{C}_7\text{H}_6\text{O}_2$ ). Therefore, (B) must be phenol,  $\text{C}_6\text{H}_5\text{OH}$ . It undergoes Reimer-Tiemann reaction to give a mixture of two isomeric compounds with molecular formula  $\text{C}_7\text{H}_6\text{O}_2$ . Thus, (D) and (E) are *o*- and *p*-hydroxybenzaldehyde.



**18. (d)**

# PRACTICE PAPER

# AIIMS

Exam on  
28<sup>th</sup> May

- The order of reactivity of following alkyl halides towards  $S_N1$  reaction is
  - $(CH_3)_3CBr$
  - $(C_6H_5)_2CHBr$
  - $(C_6H_5)_2C(CH_3)Br$
  - $(CH_3)_2CHBr$
  - $C_2H_5Br$
  - $(v) > (iv) > (i) > (ii) > (iii)$
  - $(ii) > (i) > (iii) > (v) > (iv)$
  - $(i) > (iii) > (v) > (ii) > (iv)$
  - $(iii) > (ii) > (i) > (iv) > (v)$
- In the titration of HCl vs  $NH_4OH$ , the pH at the equivalence point will be
  - less than 7
  - greater than 7
  - equal to 7
  - none of these.
- When current is passed through two cells connected in series, the first cell contains  $X(NO_3)_{3(aq)}$  and the second cell contains  $Y(NO_3)_{2(aq)}$ . The relative atomic masses of X and Y are in the ratio 1 : 2. What is the ratio of the liberated mass of X to that of Y?
  - 3 : 2
  - 1 : 2
  - 1 : 3
  - 3 : 1
- Consider the following reaction,
 
$$\text{Cyclohexanone} - \text{C}\equiv\text{CH} \xrightarrow[\text{H}_2\text{O}]{\text{HgSO}_4/\text{H}_2\text{SO}_4} A$$

The structure of the major product A' is

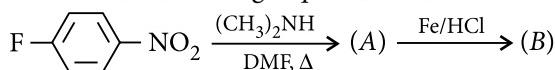
  - 
  - 
  - 
  -
- An element 'X' is strongly electropositive and element 'Y' is strongly electronegative. Both are univalent. The compound formed would be
  - $X^+ Y^-$
  - $X^- Y^+$
  - $X - Y$
  - $X \rightarrow Y$
- In the reaction,  

$$\text{BrO}_{3(aq)}^- + 5\text{Br}_{(aq)}^- + 6\text{H}_{(aq)}^+ \longrightarrow 3\text{Br}_{2(aq)} + 3\text{H}_2\text{O}_{(l)}$$
 the expression of rate of appearance of bromine  $[Br_2]$  to rate of disappearance of bromide ion  $[Br^-]$  is
  - $\frac{d[Br_2]}{dt} = -\frac{3}{5} \frac{d[Br^-]}{dt}$
  - $\frac{d[Br_2]}{dt} = -\frac{5}{3} \frac{d[Br^-]}{dt}$
  - $\frac{d[Br_2]}{dt} = \frac{5}{3} \frac{d[Br^-]}{dt}$
  - $\frac{d[Br_2]}{dt} = \frac{3}{5} \frac{d[Br^-]}{dt}$
- Consider the following reaction :
 
$$\text{Phenol} \xrightarrow{\text{Zn dust}} X \xrightarrow[\text{Anhydrous AlCl}_3]{\text{CH}_3\text{Cl}} Y \xrightarrow{\text{Alkaline KMnO}_4} Z$$

The product Z is

  - toluene
  - benzaldehyde
  - benzoic acid
  - benzene.
- A solid (A) which has photographic effect, reacts with the solution of a sodium salt (B) to give a pale yellow ppt. (C). Sodium salt (B) on heating gives brown vapours. A, B and C are respectively
  - $\text{AgNO}_3, \text{NaBr}, \text{AgBr}$
  - $\text{AgNO}_3, \text{NaCl}, \text{AgCl}$
  - $\text{AgNO}_3, \text{NaBr}, \text{AgCl}$
  - $\text{AgCl}, \text{NaBr}, \text{AgBr}$
- The number of molecules liberated at anode from molten sodium chloride in one minute by a current of 300 milliamperes is
  - $5.616 \times 10^{18}$
  - $5.616 \times 10^{19}$
  - $5.616 \times 10^{20}$
  - $5.616 \times 10^{21}$

10. Consider the following sequence of reactions :



The product (B) is

- (a)
- (b)
- (c)
- (d)

11. The true statement for the oxyacids of phosphorus

$\text{H}_3\text{PO}_2$ ,  $\text{H}_3\text{PO}_3$  and  $\text{H}_3\text{PO}_4$  is

- (a) the order of their acidity is,  
 $\text{H}_3\text{PO}_4 > \text{H}_3\text{PO}_3 > \text{H}_3\text{PO}_2$
- (b) all of them are reducing in nature
- (c) all of them are tribasic acids
- (d) the geometry of phosphorus is tetrahedral in all the three.

12. In vulcanization of rubber,

- (a) sulphur reacts to form a new compound
- (b) sulphur cross-links are introduced
- (c) sulphur forms a very thin protective layer over rubber
- (d) all statements are correct.

13. In which of the following arrangements of  $\text{XeF}_2$ ,  $\text{XeF}_4$  and  $\text{XeF}_6$ , the decreasing order of Xe—F bond length is correct?

- (a)  $\text{XeF}_2 > \text{XeF}_4 > \text{XeF}_6$  (b)  $\text{XeF}_6 > \text{XeF}_4 > \text{XeF}_2$
- (c)  $\text{XeF}_4 > \text{XeF}_6 > \text{XeF}_2$  (d)  $\text{XeF}_2 > \text{XeF}_6 > \text{XeF}_4$

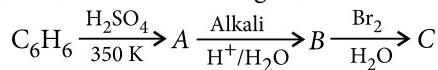
14. 2.8 g of a pure alkene containing only one double bond per molecule, reacts completely with 8 g of bromine (in an inert solvent). What is the molecular formula of the alkene?

- (a)  $\text{C}_2\text{H}_4$  (b)  $\text{C}_4\text{H}_8$
- (c)  $\text{C}_3\text{H}_6$  (d)  $\text{C}_6\text{H}_{12}$

15. The reaction,  $A \longrightarrow$  Product, follows first order kinetics. In 40 minutes, the concentration of A changes from 0.1 M to 0.025 M. The rate of reaction, when concentration of A is 0.01 M is

- (a)  $1.73 \times 10^{-4} \text{ M min}^{-1}$
- (b)  $3.47 \times 10^{-5} \text{ M min}^{-1}$
- (c)  $3.47 \times 10^{-4} \text{ M min}^{-1}$
- (d)  $1.73 \times 10^{-5} \text{ M min}^{-1}$

16. Consider the following set of reactions :



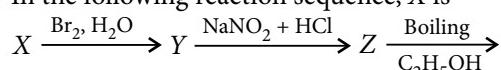
The final product, C is

- (a) o-bromophenol (b) p-bromophenol
- (c) m-bromophenol (d) 2,4,6-tribromophenol.

17. Vapour pressures of chloroform ( $\text{CHCl}_3$ ) and dichloromethane ( $\text{CH}_2\text{Cl}_2$ ) at  $25^\circ\text{C}$  are 200 mm Hg and 41.5 mm Hg respectively. Vapour pressure of the solution obtained by mixing 25.5 g of  $\text{CHCl}_3$  and 40 g of  $\text{CH}_2\text{Cl}_2$  at the same temperature will be (Molecular mass of  $\text{CHCl}_3 = 119.5 \text{ u}$  and molecular mass of  $\text{CH}_2\text{Cl}_2 = 85 \text{ u}$ )

- (a) 90.9 mm Hg (b) 615.0 mm Hg
- (c) 347.9 mm Hg (d) 285.5 mm Hg

18. In the following reaction sequence, X is

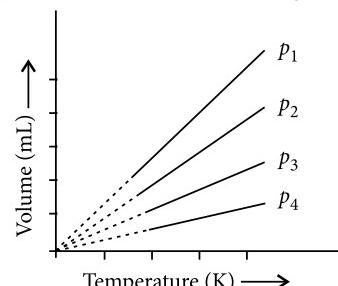


- (a) benzoic acid (b) salicylic acid
- (c) phenol (d) aniline.

19. A p-type material is electrically

- (a) positive (b) negative
- (c) neutral (d) It depends upon the concentration of p-impurities.

20. A plot of volume ( $V$ ) vs temperature ( $T$ ) for a gas at constant pressure is a straight line passing through the origin. The plots at different values of pressure are shown in the figure. Which of the following orders of pressure is correct for the gas?



- (a)  $p_1 > p_2 > p_3 > p_4$  (b)  $p_1 = p_2 = p_3 = p_4$
- (c)  $p_1 < p_2 < p_3 < p_4$  (d)  $p_1 < p_2 = p_3 < p_4$

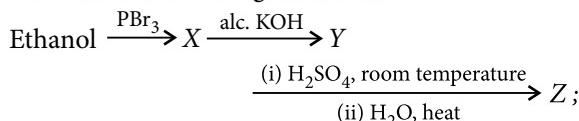
21. Which of the following reactions is an example of auto-reduction?

- (a)  $\text{Fe}_3\text{O}_4 + 4\text{CO} \longrightarrow 3\text{Fe} + 4\text{CO}_2$
- (b)  $\text{Cu}_2\text{O} + \text{C} \longrightarrow 2\text{Cu} + \text{CO}$
- (c)  $\text{Cu}^{2+} + \text{Fe} \longrightarrow \text{Cu} + \text{Fe}^{2+}$
- (d)  $\text{Cu}_2\text{O} + \frac{1}{2}\text{Cu}_2\text{S} \longrightarrow 3\text{Cu} + \frac{1}{2}\text{SO}_2$

- 22.** Which of the following reactions is not associated with the Solvay process of manufacture of sodium carbonate?

- (a)  $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3$
- (b)  $\text{NH}_3 + \text{H}_2\text{CO}_3 \rightarrow \text{NH}_4\text{HCO}_3$
- (c)  $\text{NaCl} + \text{NH}_4\text{HCO}_3 \rightarrow \text{NaHCO}_3 + \text{NH}_4\text{Cl}$
- (d)  $2\text{NaOH} + \text{CO}_2 \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O}$

- 23.** Consider the following reactions,



product Z is

- (a)  $\text{CH}_2 = \text{CH}_2$
- (b)  $\text{CH}_3\text{CH}_2 - \text{O} - \text{CH}_2\text{CH}_3$
- (c)  $\text{CH}_3 - \text{CH}_2 - \text{O} - \text{SO}_3\text{H}$
- (d)  $\text{CH}_3\text{CH}_2\text{OH}$

- 24.** Glycerol was distilled with oxalic acid crystals and the products were led into Fehling's solution and warmed. Cuprous oxide was precipitated, which is due to

- (a) CO
- (b) HCHO
- (c)  $\text{CH}_3\text{CHO}$
- (d) HCOOH

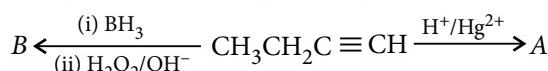
- 25.** The order of screening effect of electrons of *s*, *p*, *d* and *f* orbitals of a given shell of an atom on its outer shell electrons is

- (a)  $s > p > d > f$
- (b)  $f > d > p > s$
- (c)  $p < d < s > f$
- (d)  $f > p > s > d$

- 26.** Which of the following statements is false?

- (a) The lower the concentration of D.O., the more polluted is the water sample.
- (b) The tolerable limit of lead in drinking water is 50 ppb.
- (c) Water is considered pure if it has BOD less than 5 ppm.
- (d) In COD determination, the pollutants resistant to microbial oxidation are not oxidised by oxidising agents like  $\text{K}_2\text{Cr}_2\text{O}_7$ .

- 27.** The two compounds A and B obtained from 1-butyne can be distinguished by



- (a)  $\text{NaHSO}_3$
- (b) litmus solution
- (c) iodoform test
- (d) 2, 4-DNP

- 28.** At what temperature, the translational kinetic energy of 14 g of nitrogen will be the same as that of 32 g of oxygen at 300 K?

- (a) 150 K
- (b) 300 K
- (c) 600 K
- (d) 131.25 K

- 29.** Which of the following equations depicts reducing nature of  $\text{H}_2\text{O}_2$ ?

- (a)  $2[\text{Fe}(\text{CN})_6]^{4-} + 2\text{H}^+ + \text{H}_2\text{O}_2 \rightarrow 2[\text{Fe}(\text{CN})_6]^{3-} + 2\text{H}_2\text{O}$
- (b)  $\text{I}_2 + \text{H}_2\text{O}_2 + 2\text{OH}^- \rightarrow 2\text{I}^- + 2\text{H}_2\text{O} + \text{O}_2$
- (c)  $\text{Mn}^{2+} + \text{H}_2\text{O}_2 \rightarrow \text{Mn}^{4+} + 2\text{OH}^-$
- (d)  $\text{PbS} + 4\text{H}_2\text{O}_2 \rightarrow \text{PbSO}_4 + 4\text{H}_2\text{O}$

- 30.** Consider the reactions given below. On the basis of these reactions find out which of the algebraic relations given is correct?

- (i)  $\text{C}_{(g)} + 4\text{H}_{(g)} \rightarrow \text{CH}_4_{(g)} ; \Delta_rH = x \text{ kJ mol}^{-1}$
- (ii)  $\text{C}_{(\text{graphite, s})} + 2\text{H}_{2(g)} \rightarrow \text{CH}_4_{(g)} ; \Delta_rH = y \text{ kJ mol}^{-1}$
- (a)  $x = y$
- (b)  $x = 2y$
- (c)  $x > y$
- (d)  $x < y$

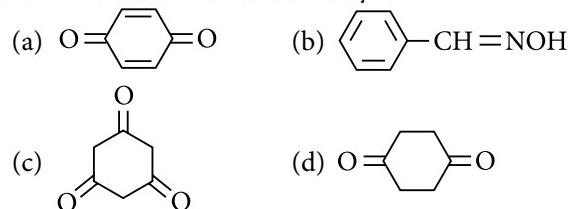
- 31.** Which of the following pairs of solutions are expected to be isotonic, temperature being the same?

- (a) 0.1 M Glucose and 0.1 M  $\text{C}_6\text{H}_5\text{NH}_3\text{Cl}$
- (b) 0.1 M NaCl and 0.05 M  $\text{BaCl}_2$
- (c) 0.1 M  $\text{Na}_2\text{SO}_4$  and 0.1 M  $\text{KNO}_3$
- (d) 0.1 M  $\text{BaCl}_2$  and 0.075 M  $\text{FeCl}_3$

- 32.** Which of the following has maximum lattice energy?

- (a)  $\text{Li}_2\text{O}$
- (b)  $\text{Na}_2\text{O}$
- (c)  $\text{MgO}$
- (d)  $\text{BaO}$

- 33.** Tautomerism is not exhibited by



- 34.** Extraction of gold and silver involves leaching the metal with  $\text{CN}^-$  ion. The metal is recovered by

- (a) displacement of metal by some other metal from the complex ion
- (b) roasting of metal complex
- (c) calcination followed by roasting
- (d) thermal decomposition of metal complex.

- 35.** Which of the following statements about DNA is not correct?

- (a) It has a double helix structure.
- (b) It undergoes replication.
- (c) The two strands in a DNA molecule are exactly similar.
- (d) It contains the pentose sugar, 2-deoxyribose.

- 36.** Which of the following actinoids shows oxidation states upto +7?  
 (a) Th      (b) Pu      (c) U      (d) Ce
- 37.** In the reaction,  
 $\text{NaOH} + \text{Al(OH)}_3 \longrightarrow \text{NaAlO}_2 + 2\text{H}_2\text{O}$   
 the equivalent mass of  $\text{Al(OH)}_3$  is  
 (a) 78      (b) 26      (c) 52      (d) unpredictable.
- 38.** To detect nitrogen in hydrazine ( $\text{NH}_2\text{NH}_2$ ) by Lassaigne's extract, it is fused with sodium in presence of  
 (a) starch      (b) charcoal  
 (c) sugar      (d) any of these.
- 39.** The percentage of nitrogen in urea is about  
 (a) 46      (b) 85      (c) 18      (d) 28
- 40.** A solution of ammonia in water contains  
 (a)  $\text{H}^+$       (b)  $\text{OH}^-$   
 (c)  $\text{NH}_4^+$       (d)  $\text{OH}^-$ ,  $\text{NH}_4^+$  and  $\text{NH}_4\text{OH}$ .

#### ASSERTION AND REASON

**Directions :** In the following questions (41-60), a statement of assertion is followed by a statement of reason. Mark the correct choice as :

- (a) If both assertion and reason are true and reason is the correct explanation of assertion.
- (b) If both assertion and reason are true but reason is not the correct explanation of assertion.
- (c) If assertion is true but reason is false.
- (d) If both assertion and reason are false.

- 41. Assertion :** An ionic product is used for any type of electrolytes whereas solubility product is applicable only to sparingly soluble salts.

**Reason :** Ionic product is defined at any state of the reaction whereas solubility product is only applicable to the saturation stage.

- 42. Assertion :**  $\text{NO}_3^-$  is trigonal planar while  $\text{NH}_3$  is pyramidal.

**Reason :** N in  $\text{NO}_3^-$  is  $sp^2$  and in  $\text{NH}_3$ , it is  $sp^3$  hybridised.

- 43. Assertion :** Deep electric shock causes death of an animal.

**Reason :** Electric shock coagulates the blood.

- 44. Assertion :** Aldol condensation can be catalysed both by acids and bases.

**Reason :**  $\beta$ -Hydroxyaldehydes or ketones readily undergo acid-catalysed dehydration.

- 45. Assertion :** Due to Frenkel defect, there is no effect on the density of the crystalline solid.

**Reason :** In Frenkel defect, no cation or anion leaves the crystal.

- 46. Assertion :**  $\text{HNO}_3$  makes iron passive.  
**Reason :**  $\text{HNO}_3$  forms a protective layer of ferric nitrate on the surface of iron.

- 47. Assertion :** Benzonitrile is prepared by the reaction of chlorobenzene with potassium cyanide.

**Reason :** Cyanide ion ( $\text{CN}^-$ ) is a weak nucleophile.

- 48. Assertion :** At constant temperature,  $PV$  vs  $V$  plot for real gases is not a straight line.

**Reason :** At high pressure, all gases have  $Z > 1$  but at intermediate pressure, most gases have  $Z < 1$ .

- 49. Assertion :** A spectral line will be seen for  $2p_x$  to  $2p_y$  transition.

**Reason :** Energy is released in the form of wave of light when the electrons drop from  $2p_x$  to  $2p_y$  orbital.

- 50. Assertion :** Hydrolysis of (-)-2-bromoocetane proceeds with inversion of configuration.

**Reason :** This reaction proceeds through the formation of a carbocation.

- 51. Assertion :** Colloidal solutions show colligative properties.

**Reason :** Colloidal particles are large in size than particles of true solution.

- 52. Assertion :** Both  $\text{H}_3\text{PO}_3$  and  $\text{H}_3\text{PO}_4$  have the same number of hydrogen atoms but  $\text{H}_3\text{PO}_4$  is a tribasic acid and  $\text{H}_3\text{PO}_3$  is a dibasic acid.

#### Form IV

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I, Mahabir Singh, authorised signatory for MTG Learning Media Pvt. Ltd. hereby declare that particulars given above are true to the best of my knowledge and belief.

For MTG Learning Media Pvt. Ltd.  
 Mahabir Singh  
 Director

**Reason :** One mole of each  $\text{H}_3\text{PO}_3$  and  $\text{H}_3\text{PO}_4$  is neutralized by 2 moles and 3 moles of  $\text{NaOH}$  respectively.

53. **Assertion :** The enthalpy of reaction remains constant in the presence of a catalyst.

**Reason :** A catalyst participating in the reaction, forms different activated complex and lowers down the activation energy but the difference in energy of reactant and product remains the same.

54. **Assertion :** Reducing character of hydrides of oxygen family increases from  $\text{H}_2\text{S}$  to  $\text{H}_2\text{Te}$ .

**Reason :** Thermal stability decreases from  $\text{H}_2\text{S}$  to  $\text{H}_2\text{Te}$ .

55. **Assertion :** For the Daniell cell :  $\text{Zn} | \text{Zn}^{2+} \parallel \text{Cu}^{2+} | \text{Cu}$  with  $E_{\text{cell}} = 1.1 \text{ V}$ , the application of opposite potential greater than 1.1 V results into the flow of electrons from cathode to anode.

**Reason :** Zinc is deposited at anode and copper is dissolved at cathode.

56. **Assertion :** Lattice energy in  $\text{TiO}_2$  will be much larger than in  $\text{NaCl}$ .

**Reason :** The higher value of lattice energy for  $\text{TiO}_2$  as compared to that of  $\text{NaCl}$  is due to increased ionic charge.

57. **Assertion :** One molal aqueous solution of glucose contains 180 g of glucose in 1 kg water.

**Reason :** Solution containing one mole of solute in 1000 g of solvent is called one molal solution.

58. **Assertion :**  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$  is coloured while  $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$  is colourless.

**Reason :**  $d-d$  transition is not possible in  $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$ .

59. **Assertion :** The non-fusible impurities present in iron ore are removed by  $\text{CaCO}_3$ .

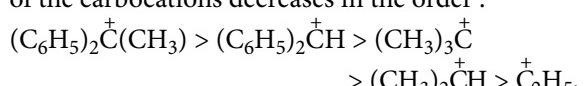
**Reason :**  $\text{CaCO}_3$  decomposes to  $\text{CaO}$  which reacts with  $\text{SiO}_2$  to form  $\text{CaSiO}_3$  slag.

60. **Assertion :** As a lead storage battery gets discharged, density of electrolyte present in it, decreases.

**Reason :** Lead and lead dioxide both react with sulphuric acid to form lead sulphate.

## SOLUTIONS

1. **(d) :** More stable the carbocation, more reactive is the alkyl halide in  $\text{S}_{\text{N}}1$  reaction. Since the stability of the carbocations decreases in the order :



therefore, reactivity of the alkyl halides decreases in the same order :

(iii) > (ii) > (i) > (iv) > (v).

2. **(a) :** At the equivalence point, equal number of moles of acid and base added and the pH will reflect which species are present.

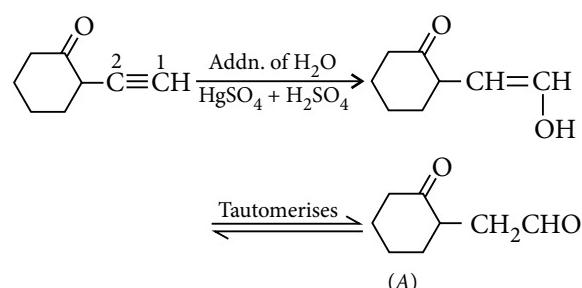
3. **(c) :** If atomic mass of  $X = a$ , then that of  $Y = 2a$   
As Eq. wt. = Atomic mass/Valency

$$\text{Eq. wt. of } X = \frac{a}{3}, \text{ Eq. wt. of } Y = \frac{2a}{2} = a$$

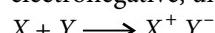
According to Faraday's second law;

$$\frac{\text{Liberated Mass of } X}{\text{Liberated Mass of } Y} = \frac{\text{Eq. wt. of } X}{\text{Eq. wt. of } Y} \\ = \frac{a/3}{a} = \frac{1}{3} = 1 : 3$$

4. **(b) :** Due to electron withdrawing nature of the keto group, the  $\text{C}_1$ -atom becomes electron deficient. Hence, it is attacked by the nucleophile  $\text{H}_2\text{O}$  as shown :



5. **(a) :** Strongly electropositive, univalent,  $X$  will form an 1 : 1 ionic compound with strongly electronegative, univalent  $Y$ .



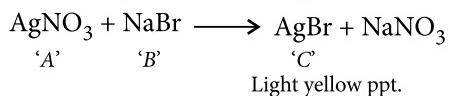
6. **(a) :**  $\frac{1}{3} \frac{d[\text{Br}_2]}{dt} = -\frac{1}{5} \frac{d[\text{Br}^-]}{dt}$

$$\frac{d[\text{Br}_2]}{dt} = -\frac{3}{5} \frac{d[\text{Br}^-]}{dt}$$

7. **(c) :** Phenol  $\xrightarrow{\text{Zn dust}}$  Benzene  $\xrightarrow[\text{anhy. AlCl}_3]{\text{CH}_3\text{Cl}}$  Toluene  $\xrightarrow[\text{KMnO}_4]{\text{alk.}}$  Benzoic acid

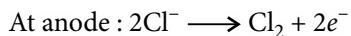
8. **(a) :** Solid (A) is silver nitrate which has photographic effect, reacts with the solution of  $\text{NaBr}(B)$  to give a pale yellow ppt. of  $\text{AgBr}$ .  $\text{NaBr}(B)$

on heating gives brown vapours of bromine.



**9. (b) :** Quantity of electricity passed

$$= \frac{300}{1000} \times 60 = 18 \text{ coulombs}$$



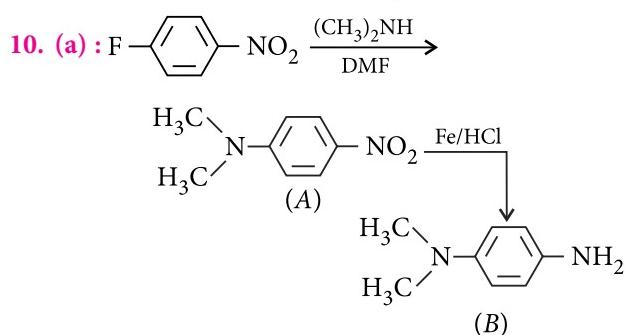
$2F = 2 \times 96500$  coulombs liberate 1 mole of  $\text{Cl}_2$

$\therefore 18$  coulombs will liberate

$$= \frac{1}{2 \times 96500} \times 18 \text{ mole of } \text{Cl}_2$$

$$= \frac{1}{2 \times 96500} \times 18 \times 6.022 \times 10^{23} \text{ molecules}$$

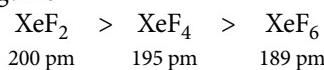
$$= 5.616 \times 10^{19} \text{ molecules of } \text{Cl}_2$$



**11. (d) :** The geometry of P in  $\text{H}_3\text{PO}_2$ ,  $\text{H}_3\text{PO}_3$  and  $\text{H}_3\text{PO}_4$  is tetrahedral.

**12. (b) :** Sulphur cross-links are introduced.

**13. (a) :** The correct decreasing order of Xe—F bond length is



Bond shortening with increase in highly electronegative F atoms attached to Xe can be explained in terms of increase in charge on Xe atom.

**14. (b) :** 8 g  $\text{Br}_2$  reacts with 2.8 g of alkene, therefore,

$$\text{mol. wt. of alkene} = \frac{2.8}{8} \times 160 = 56$$

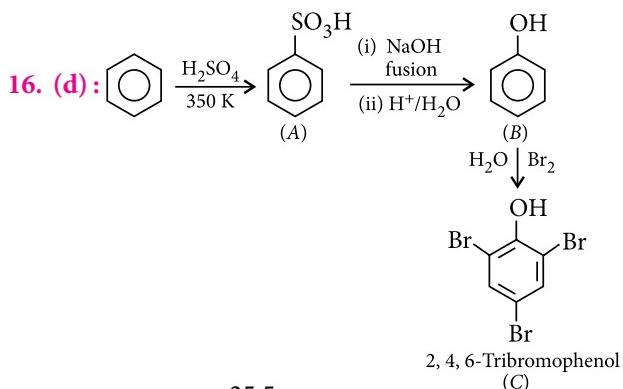
Thus, the alkene is  $\text{C}_4\text{H}_8$  ( $4 \times 12 + 8 \times 1 = 56$ )

**15. (c) :** For first order reaction,

$$k = \frac{2.303}{t} \log \frac{[A]_0}{[A]} \Rightarrow \frac{2.303}{40} \log \frac{0.1}{0.025}$$

$$k = \frac{2.303 \times 0.603}{40} \Rightarrow k = 0.0347 \text{ min}^{-1}$$

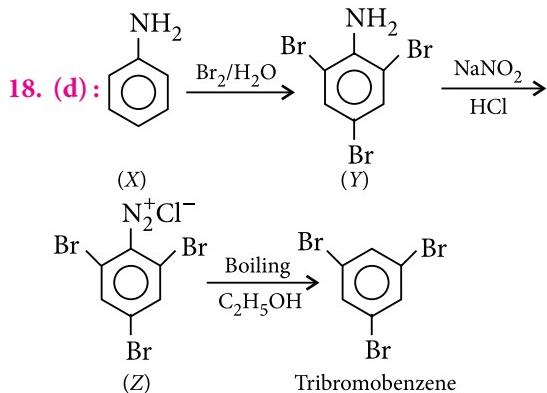
$$\text{Rate} = k[A] = 0.0347 \times 0.01 = 3.47 \times 10^{-4} \text{ M min}^{-1}$$



$$17. (a) : n_{\text{CHCl}_3} = \frac{25.5}{119.5} = 0.213$$

$$n_{\text{CH}_2\text{Cl}_2} = \frac{40}{85} = 0.47$$

$$P_T = P_A^o x_A + P_B^o x_B = 200 \times \frac{0.213}{0.683} + 41.5 \times \frac{0.47}{0.683} = 62.37 + 28.55 = 90.92 \text{ mm Hg}$$

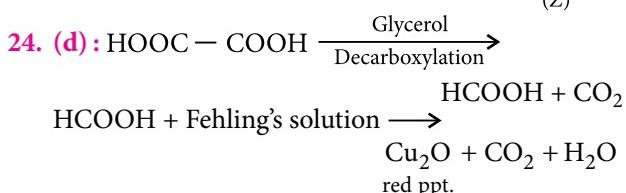
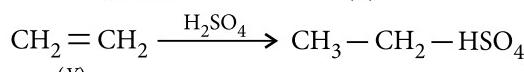
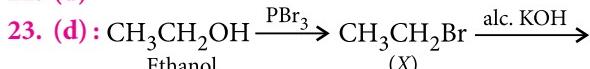


**19. (c) :** A p-type material is electrically neutral as there are only holes and no extra electrons.

**20. (c) :** Since  $pV \propto T$  and  $p \propto \frac{1}{V}$  hence, volume decreases with pressure. Hence, the order of pressure is  $p_1 < p_2 < p_3 < p_4$ .

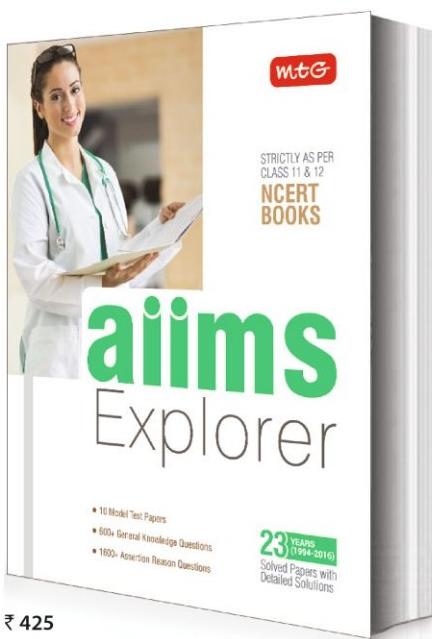
**21. (d) :** Here cuprous ions reduce itself to Cu.

**22. (d)**

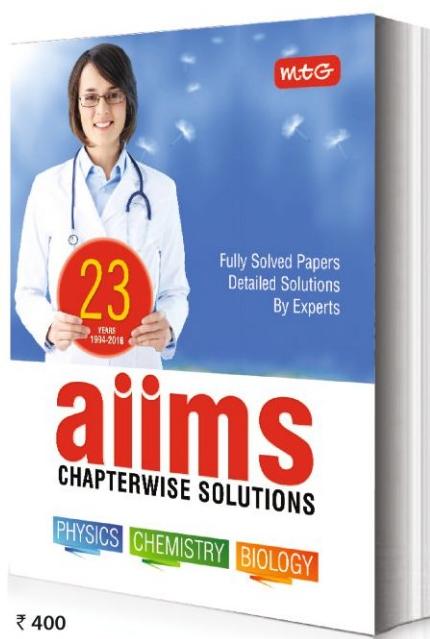


- 25. (a)** : The screening effect of the orbitals is of the order :  $s > p > d > f$ .
- 26. (d)** : In COD determination, the pollutants resistant to microbial oxidation are also oxidised by oxidising agents like  $K_2Cr_2O_7$ .
- 27. (c)** :  $CH_3CH_2CH_2CHO \xleftarrow[(ii) H_2O_2/OH^-]{(i) BH_3} CH_3CH_2C \equiv CH$   
 (an aldehyde)  
 $CH_3CH_2C \equiv CH \xrightarrow{(B)} CH_3CH_2COCH_3$   
 (A ketone with  $-COCH_3$  group)  
 $\xrightarrow{(A)}$
- 28. (c)** :  $K.E. = \frac{3}{2}nRT$ ;  $n_{N_2} = \frac{14}{28} = 0.5 \text{ mol}$ ;  $T_{N_2} = ?$   
 $n_{O_2} = \frac{32}{32} = 1 \text{ mol}$ ;  $T_{O_2} = 300 \text{ K}$   
 Given,  $K.E. (N_2) = K.E. (O_2)$ , so  $n_{N_2} T_{N_2} = n_{O_2} T_{O_2}$   
 or  $0.5 \times T_{N_2} = 1 \times 300$  or  $T_{N_2} = 600 \text{ K}$
- 29. (b)** :  $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$   
 $I_2$  is reduced to  $I^-$ . Thus,  $H_2O_2$  acts as a reducing agent.
- 30. (c)** :  $x > y$  because same bonds are formed in reactions (i) and (ii) but bonds between reactant molecules are broken only in reaction (ii). As energy is absorbed when bonds are broken so, energy released in reaction (i) is greater than that in reaction (ii).
- 31. (d)** : Effective molarity of  $BaCl_2 = 3 \times 0.1 = 0.3$  ; effective molarity of  $FeCl_3 = 4 \times 0.075 = 0.3$ .
- 32. (c)** : In  $MgO$ ,  $Mg^{2+}$  ion is smallest in size and double the charge in comparison to  $Li^+$  and  $Na^+$  ions.
- 33. (a)** : Quinone has an  $\alpha$ -hydrogen, however, it is a vinylic hydrogen, so it is very difficult to abstract such a hydrogen and hence, it does not show tautomerism.
- 34. (a)** : The metal in cyanide process is recovered by displacement of metal by some more reactive metal from the complex.  
 $4M + 8CN^- + 2H_2O + O_2 \rightarrow 4[M(CN)_2]^- + 4OH^-$   
 $2[M(CN)_2]^- + Zn \rightarrow [Zn(CN)_4]^{2-} + 2M$
- 35. (c)** : The two strands in a DNA molecule are not exactly similar but are complementary.
- 36. (b)** : Pu shows +7 oxidation state.
- 37. (c)** : 1 equivalent of  $NaOH \equiv$  1 equivalent of  $Al(OH)_3$   
 $\therefore 40 \text{ g of } NaOH \equiv 78 \text{ g of } Al(OH)_3$   
 Hence, equivalent mass of  $Al(OH)_3 = 78$ .
- 38. (d)** : Since  $NH_2NH_2$  does not contain carbon, therefore, during fusion  $NaCN$  which is essential for positive Lassaigne's test for N, cannot be formed. Therefore, to form  $NaCN$ ,  $NH_2NH_2$  is fused with a carbon containing compound such as starch, sugar or even charcoal.
- 39. (a)** :  $NH_2CONH_2 \equiv 2N$   
 $1 \text{ mol} \quad 2 \text{ g atoms}$   
 $60 \text{ g} \quad 28 \text{ g}$   
 $\therefore \text{Percentage of N} = \frac{28}{60} \times 100 = 46\%$
- 40. (d)** :  $NH_3$  when dissolved in water forms,  
 $NH_3 + H_2O \longrightarrow NH_4^+ + OH^- \rightleftharpoons NH_4OH$
- 41. (b)**      **42. (a)**      **43. (a)**
- 44. (b)** : Both carbanion (formed in presence of a base) and enol form (formed in presence of an acid) act as nucleophiles and hence, react with the carbonyl group of aldehydes and ketones to give aldols. These, aldols are further dehydrated in presence of an acid to give  $\alpha, \beta$ -unsaturated aldehydes or ketones.
- 45. (a)** : In a Frenkel defect, an ion leaves its position in the lattice and occupies normally vacant interstitial position. Hence, density remains the same.
- 46. (c)** : Passivity is attained by formation of a thin film of oxide on iron.
- 47. (d)** : Aryl halides (chlorobenzene) do not undergo nucleophilic substitution with  $KCN$  because of the low reactivity of the Cl atom, which is because of resonance in chlorobenzene.  $CN^-$  is a strong nucleophile.
- 48. (b)** : At constant temperature, plot of  $PV$  vs  $V$  for real gases is not linear because real gases have intermolecular forces of attraction.
- 49. (d)** :  $2p_x$  and  $2p_y$  have same energy, so neither energy will be released nor spectral line will be seen.
- 50. (c)** : Reaction follows  $S_N2$  mechanism which does not proceed through a carbocation formation.
- 51. (b)**      **52. (b)**      **53. (a)**      **54. (a)**
- 55. (c)** : The application of opposite potential greater than 1.1 V result into the flow of electron from cathode to anode and zinc is deposited at zinc electrode (cathode) and copper is dissolved at copper electrode (anode).
- 56. (a)**
- 57. (a)** : Molality = 
$$\frac{\text{Number of moles of solute}}{\text{Weight of solvent (in kg)}}$$
  
 If number of moles of solute = 1  
 Weight of solvent = 1 kg  
 then, molality = 1, i.e., one molal solution  
 For glucose ( $C_6H_{12}O_6$ ), molecular weight = 180  
 number of moles =  $180/180 = 1$   
 Weight of water = 1 kg  
 Hence, molality of the solution is one.
- 58. (a)**      **59. (a)**
- 60. (a)** : Sulphuric acid is consumed due to formation of lead sulphate and hence, density decreases. ♦♦

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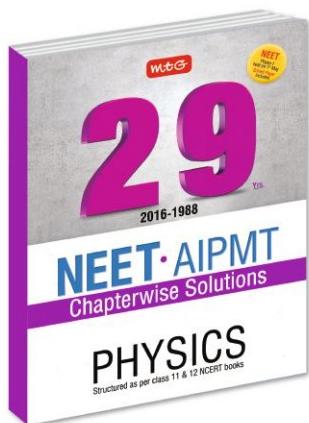


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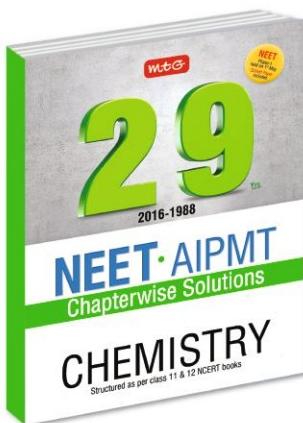


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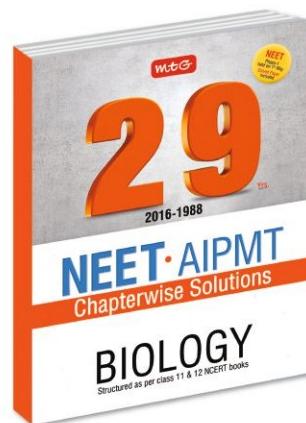
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# CHEMISTRY MUSING

## SOLUTION SET 43

1. (d) :  $pV = nRT$

$$pV = \frac{w}{M} RT; p_{O_2} V = \frac{w}{32} RT; p_{N_2} V = \frac{w}{28} RT$$

$$\frac{p_{O_2}}{p_{N_2}} = \frac{28}{32}; p_{O_2} = 0.875 p_{N_2}$$

2. (a) : No. of atoms in unit cell = 1 + 2 = 3

Volume of unit cell =  $24 \times 10^{-24} \text{ cm}^3$

Density =  $7.2 \text{ g cm}^{-3}$

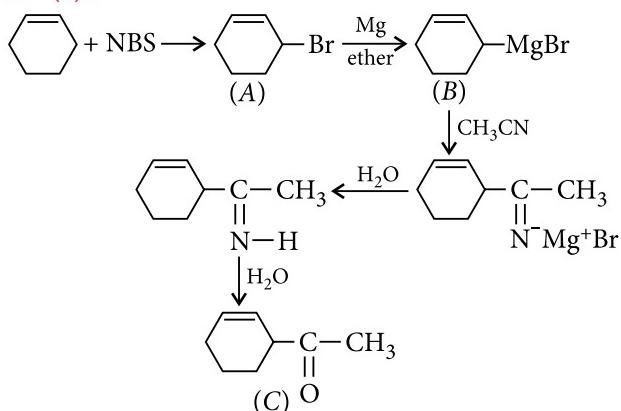
$$\text{Now, density} = \frac{n \times \text{At.wt.}}{V \times N_A}$$

$$\therefore 7.2 = \frac{3 \times \text{At.wt.}}{24 \times 10^{-24} \times 6.023 \times 10^{23}} \Rightarrow \text{At. wt.} = 34.69 \text{ g}$$

As, 34.69 g of element contains  $6.023 \times 10^{23}$  atoms

$$\therefore 200 \text{ g has } \frac{6.023 \times 10^{23} \times 200}{34.69} \text{ atoms} = 3.4724 \times 10^{24} \text{ atoms} \approx 3.5 \times 10^{24} \text{ atoms}$$

3. (b) :



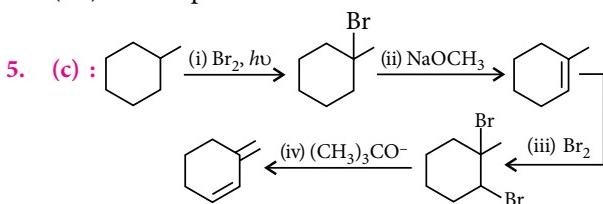
Due to the presence of  $\alpha$ -hydrogen it can participate in aldol reaction but will not give Cannizzaro reaction. Also, carbonyl group undergoes Clemmensen reduction in presence of Zn/HCl.

4. (c) : (I) Four unpaired electrons.

(II) Three unpaired electrons.

(III) Five unpaired electrons.

(IV) One unpaired electron.



6. (a) : We know,  $K_{sp}(\text{PbS}) = [\text{Pb}^{2+}][\text{S}^{2-}]$

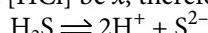
Since, the lead salt is completely dissociated,  $[\text{Pb}^{2+}]$  is equal to the concentration of the lead salt, i.e.,  $[\text{Pb}^{2+}] = 0.001 \text{ M}$ . If  $[\text{S}^{2-}]$  is the concentration of S<sup>2-</sup> required to just start the precipitation of PbS,

$$[\text{S}^{2-}] = \frac{3.4 \times 10^{-28}}{0.001} = 3.4 \times 10^{-25} \text{ M}$$

Now, the addition of HCl will suppress the dissociation of H<sub>2</sub>S to that extent that is  $[\text{S}^{2-}] = 3.4 \times 10^{-25} \text{ M}$ .

As, HCl is completely ionised.  $\therefore [\text{H}^+] = [\text{HCl}]$

Let [HCl] be  $x$ , therefore,  $[\text{H}^+] = x$



At equilibrium,  $[\text{H}_2\text{S}] = 0.1 - 3.4 \times 10^{-25} \approx 0.1$

$$[\text{H}^+] = 2 \times 3.4 \times 10^{-25} + x \approx x$$

$$[\text{S}^{2-}] = 3.4 \times 10^{-25}$$

$$\therefore K_a = \frac{[\text{H}^+]^2[\text{S}^{2-}]}{[\text{H}_2\text{S}]}$$

$$1.1 \times 10^{-23} = \frac{x^2(3.4 \times 10^{-25})}{0.1}$$

$$x^2 = \frac{0.1 \times 1.1 \times 10^{-23}}{3.4 \times 10^{-25}} \Rightarrow x^2 = 3.2356$$

$$x = 1.80 \Rightarrow [\text{HCl}] = 1.80 \text{ M}$$

Thus, any concentration of HCl greater than 1.80 M will just prevent the precipitation of PbS.

7. (d) :  $\text{AlH}_4^- = sp^3$ , tetrahedral =  $18e^-$

$\text{BH}_4^- = sp^3$ , tetrahedral =  $10e^-$

$\text{AlCl}_4^- = sp^3$ , tetrahedral =  $82e^-$

8. (a) : In  $\text{Al}(\text{BH}_4)_3$ , each  $\text{BH}_4^-$  forms two hydrogen bridges.

9. (3) : Compounds containing carbonyl group will exhibit both nucleophilic addition reaction as well as Wolff-Kishner reduction reaction.

10. (2) :  $B^{n+} \longrightarrow B^{(n+4)+}$

millimoles at  $t = 0$  :  $a \quad 0 \quad B^{n+} \rightarrow B^{(n+2)+} + 2e^-$   
 $t = 10$  :  $(a - x) \quad x \quad 5e^- + B^{(n+4)+} \rightarrow B^{(n-1)+}$

Let normality be  $N$  for reducing agent.

Thus, at  $t = 0$ ,  $a \times 2 = N \times 25$ ;  $\therefore a = \frac{25}{2}N$

At  $t = 10$ ,  $(a - x) \times 2 + x \times 5 = N \times 32$   
 for  $B^{n+}$  for  $B^{(n+4)+}$

$$\therefore 3x = 7N \text{ or } x = \frac{7}{3}N$$

$$\text{Now, } k = \frac{2.303}{10} \log \left( \frac{25/2N}{\frac{25}{2} - \frac{7}{3}N} \right) = \frac{2.303}{10} \log \frac{25 \times 6}{2 \times 61}$$

$$k = 2.07 \times 10^{-3} \text{ min}^{-1} \approx 2 \times 10^{-3} \text{ min}^{-1} \Rightarrow x = 2$$

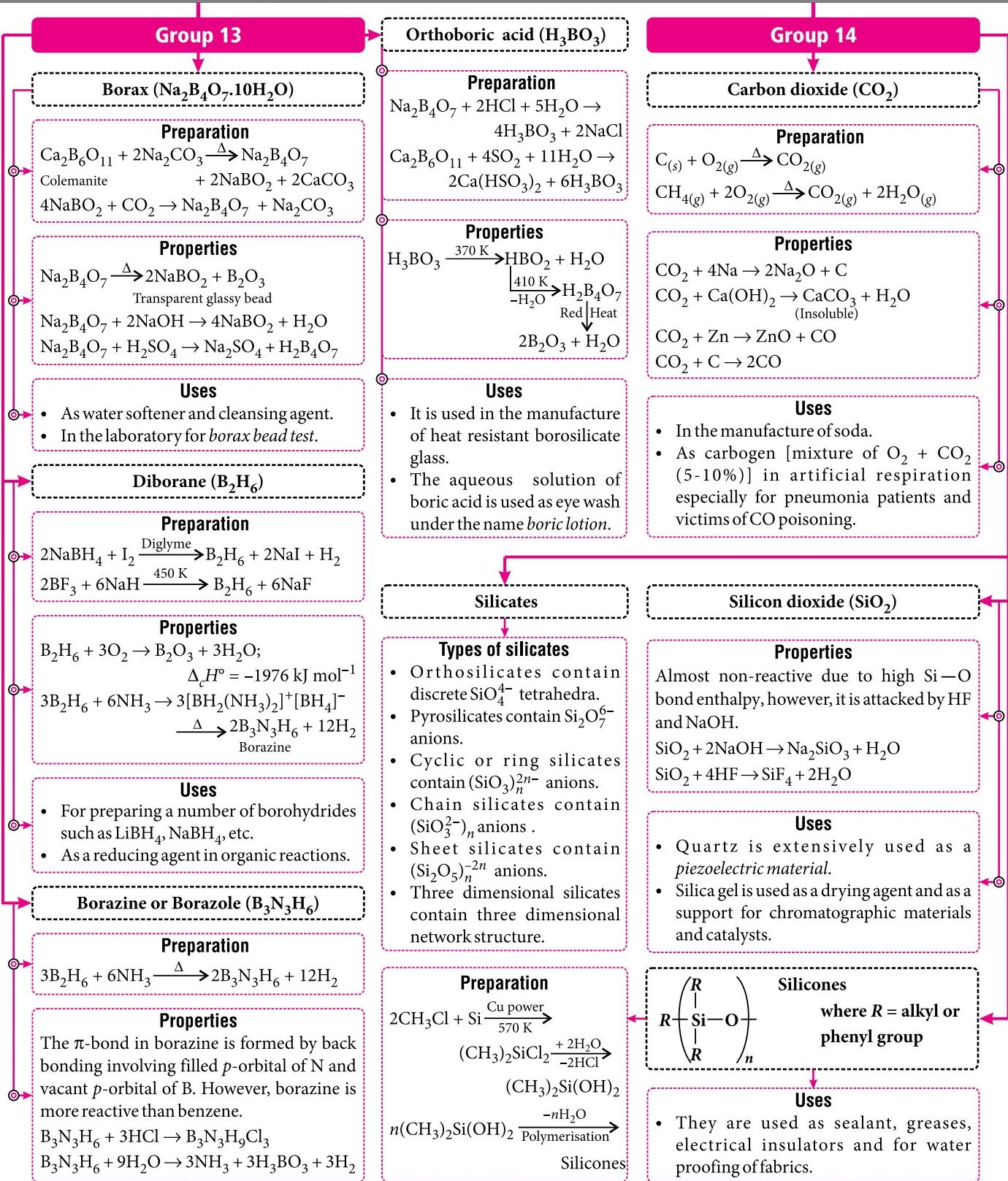


## **SOME IMPORTANT COMPOUNDS OF GROUP 13 & GROUP 14**



# CONCEPT MAP

Boron and silicon compounds find applications in industry and technology. Agriculture, fire retardants, soaps and detergents rely on boron compounds. Silicon compounds are useful in glass making and electronic devices. Carbon dioxide being heavy and non-supporter of combustion, is used as fire-extinguisher.



## Class XII

# STEREOCHEMISTRY

## CONCEPT MAP

Stereochemistry is a unique part of chemistry concerned with the study of the spatial arrangement of atoms and molecules in the compound, its effect on chemical reaction and relations to the properties of compounds. It is also known as 3D chemistry. Different enantiomers have different selectivity for biological targets and have different biological actions. Hence, stereochemistry have great importance in pharmaceutical industry.

### Stereoisomers

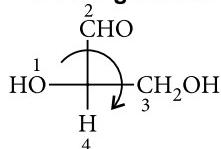
The isomers that are different from each other only in the way the atoms are oriented in space are called *stereoisomers*.

#### Absolute Configuration (R and S system of nomenclature)

In order to designate absolute configurations a system of nomenclature called *Cahn-Ingold-Prelog system* has been developed.

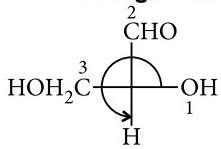
- Assign priority to the groups attached. Higher atomic number will get higher priority.
- The H atom or group of lowest priority is brought vertically in Fischer projection.

#### R-configuration



Move the arrow in order of decreasing priority. If it rotates clockwise, configuration is R (*rectus*) configuration.

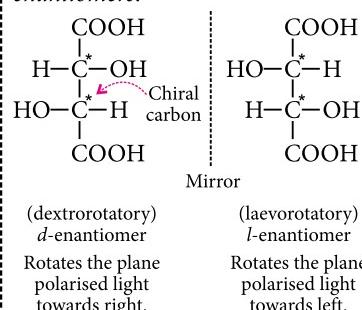
#### S-configuration



Move the arrow in order of decreasing priority. If it rotates anti-clockwise, then the configuration is S (*sinister*) configuration.

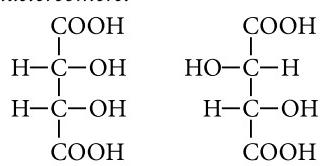
#### Enantiomers

Stereoisomers having non superimposable mirror images are optically active and these are called *enantiomers*.



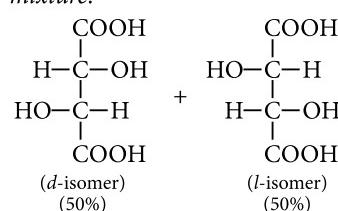
#### Diastereomers

Stereoisomers that are not mirror images of each other are called *diastereomers*.



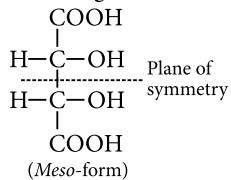
#### Racemic mixture

If both *d* and *l* enantiomers present in equal amount (50-50%) then the mixture is optically inactive due to external compensation, the mixture is known as *racemic mixture*.



#### Meso form

If plane of symmetry is present in the molecule then, one of the isomer will be optically inactive due to internal compensation because half of the molecule will rotate the plane polarised light towards right and another half towards left. So, total rotation of plane polarised light will be zero.



#### In unsymmetrical molecule

Number of enantiomers =  $2^n$   
 Meso forms = 0  
 Total optical isomers =  $2^n$   
 where,  $n$  = number of chiral or asymmetric carbon atoms.

#### In symmetrical molecule

- When  $n$  is odd,  
 Number of enantiomers =  $2^{(n-1)} - 2^{(0.5n - 0.5)}$   
 Meso forms =  $2^{(0.5n - 0.5)}$   
 Total optical isomers =  $2^{(n-1)}$
- When  $n$  is even,  
 Number of enantiomers =  $2^{(n-1)}$   
 Meso forms =  $2^{(n/2 - 1)}$   
 Total optical isomers =  $2^{(n-1)} + 2^{(n/2 - 1)}$

#### Resolution of racemic mixture

The process of separation of a racemic mixture into *d*- and *l*-forms is called *resolution*.

Following are the methods by which a racemic mixture can be resolved:

- Mechanical separation
- Biochemical separation
- Chemical separation
- Chromatographic method
- Selective adsorption method

#### Racemisation

Conversion of (+) or (-) isomer into its racemic mixture ( $\pm$ ) is known as *racemisation*. It is reverse of resolution and can be carried out either by heat, light or use of chemical reagents, etc.

# NEET | JEE ESSENTIALS

Class  
XI

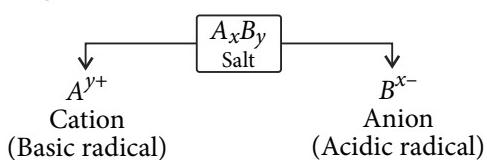
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## Unit 9

## PRINCIPLES RELATED TO PRACTICAL CHEMISTRY

### SALT ANALYSIS

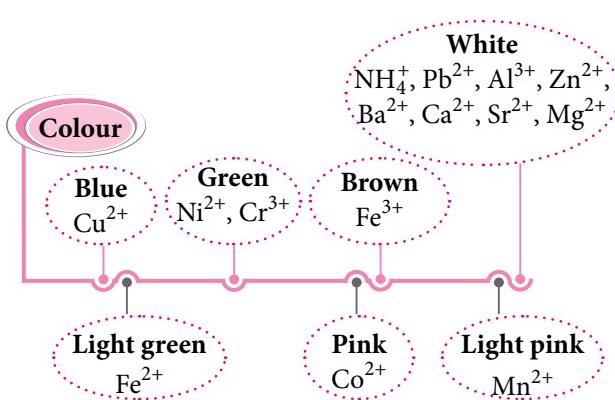
The qualitative salt analysis deals with the identification of acidic radicals (anions) and basic radicals (cations) in an inorganic salt or in a mixture of salts.



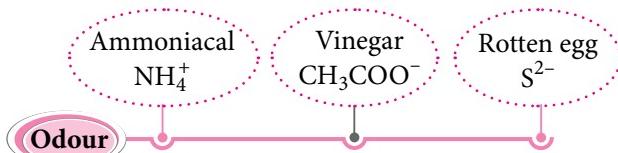
### PRELIMINARY TESTS

☛ Note the state (amorphous or crystalline) and colour of the salt.

☛ Colour of the salt :



☛ Odour of the salt :

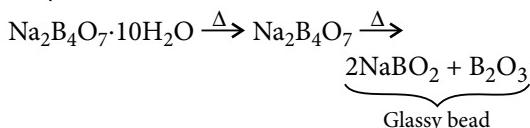


☛ Flame test :

$\text{Cu}^{2+}$ ← Greenish blue	Salt with 1-2 drops of conc. HCl is introduced in the non-luminous (oxidising part) flame of the Bunsen burner using platinum wire.	Brick red → $\text{Ca}^{2+}$
$\text{K}^+$ ← Lilac		Apple green → $\text{Ba}^{2+}$
$\text{Na}^+$ ← Golden yellow		Crimson red → $\text{Sr}^{2+}$

☛ Borax bead test :

- Borax is heated on a loop of Pt wire, colourless glassy bead of sodium metaborate and boric anhydride is formed.



- Coloured salts are then heated on the glassy bead, coloured metaborate is formed in the oxidising flame.

Colour of bead in oxidising flame	Ion indicated
Green in hot, light brown in cold	Copper
Pinkish violet in both hot and cold	Manganese
Yellowish brown in hot and pale yellow in cold	Iron
Brown in hot and pale brown in cold	Nickel

## ANIONS OR ACIDIC RADICALS

### Anions

First group :  $\text{CO}_3^{2-}$ ,  $\text{S}^{2-}$ ,  $\text{SO}_3^{2-}$ ,  $\text{CH}_3\text{COO}^-$ ,  $\text{S}_2\text{O}_3^{2-}$ ,  $\text{NO}_2^-$

Second group :  $\text{Br}^-$ ,  $\text{Cl}^-$ ,  $\text{I}^-$ ,  $\text{NO}_3^-$ ,  $\text{C}_2\text{O}_4^{2-}$

Third group :  $\text{SO}_4^{2-}$ ,  $\text{PO}_4^{3-}$

### First group :

Group reagent : dil. HCl

Salt + dil. HCl

Effervescence or evolution of gas shows presence of 1<sup>st</sup> group

Colourless gas with suffocating smell with yellow ppt. of sulphur  $\xrightarrow{\text{Pass through K}_2\text{Cr}_2\text{O}_7}$   
Blackish green solution  $\rightarrow \text{S}_2\text{O}_3^{2-}$  confirmed

Brown gas ( $\text{NO}_2$ )  $\xrightarrow{\text{Starch iodide paper}}$  Blue  $\rightarrow \text{NO}_2^-$  confirmed

Colourless gas with vinegar smell ( $\text{CH}_3\text{COO}^-$  may be present) Salt solution +  $\text{FeCl}_3$  (neutral)  $\rightarrow (\text{CH}_3\text{COO})_3\text{Fe} \rightarrow \text{CH}_3\text{COO}^-$  confirmed  
Blood red colour solution

Colourless gas with suffocating smell ( $\text{SO}_2$ )  
 $\xrightarrow{\text{Heat and pass through K}_2\text{Cr}_2\text{O}_7}$  Solution turns green due to  $\text{Cr}_2(\text{SO}_4)_3 \rightarrow \text{SO}_3^{2-}$  confirmed

Colourless gas with rotten egg smell ( $\text{H}_2\text{S}$  gas)  
 $\xrightarrow{\text{Lead acetate}}$   $\text{PbS} \rightarrow \text{S}^{2-}$  confirmed  
Black ppt.

- Colourless and odourless gas ( $\text{CO}_2$  gas)  $\xrightarrow{\text{Lime water}}$   $\text{CaCO}_3$  ( $\text{CO}_3^{2-}$  or  $\text{HCO}_3^-$  may be present) milky
- Confirmation test for  $\text{HCO}_3^-$  &  $\text{CO}_3^{2-}$

Salt + water  $\rightarrow$  boil and pass through lime water

Lime water turns milky  
 $\downarrow$   
 $\text{HCO}_3^-$  confirmed

Lime water does not turn milky  
 $\downarrow$   
 $\text{CO}_3^{2-}$  confirmed

### Second group :

Group reagent : Conc.  $\text{H}_2\text{SO}_4$

Salt + conc.  $\text{H}_2\text{SO}_4$

Heat if required

Effervescence or evolution of gas shows presence of 2<sup>nd</sup> group

Colourless gas with pungent smell ( $\text{HCl}$  gas)

Glass rod dipped in  $\text{NH}_4\text{OH}$  is exposed

White fumes ( $\text{NH}_4\text{Cl}$ )  
 $\downarrow$   
 $\text{Cl}^-$  may be present

Brown gas

Pieces of copper turning

More brown fumes with blue solution  
 $\downarrow$   
 $\text{NO}_3^-$  may be present

Not a blue solution  
 $\downarrow$   
 $\text{Br}^-$  may be present

Violet gas ( $\text{I}_2$ )

$\downarrow \text{MnO}_2 + \text{H}_2\text{SO}_4$

Violet colour intensifies (more  $\text{I}_2$ )  
 $\downarrow$   
 $\text{I}^-$  may be present

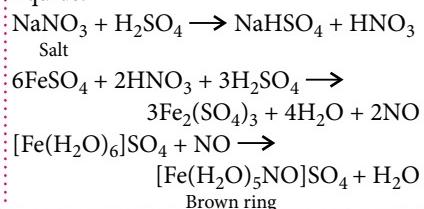
Colourless and odourless gas ( $\text{CO} + \text{CO}_2$ )  
 $\downarrow \text{Burn}$

Blue flame  
 $\downarrow$   
 $\text{C}_2\text{O}_4^{2-}$  may be present

## Confirmatory tests of acid radicals :

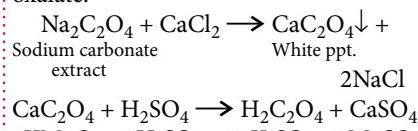
### Nitrate ( $\text{NO}_3^-$ )

**Brown ring test :** On treating aqueous solution of salt with freshly prepared solution of ferrous sulphate and concentrated sulphuric acid, gives a brown ring at the junction of two liquids.



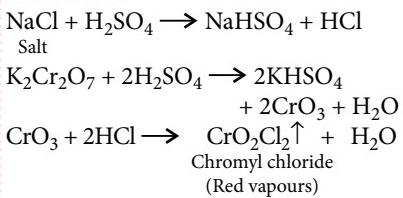
### Oxalate ( $\text{C}_2\text{O}_4^{2-}$ )

On acidifying sodium carbonate extract with acetic acid and on adding cadmium chloride solution gives white precipitate. Filter and dissolve the precipitate in dilute sulphuric acid and add few drops of potassium permanganate solution. The colour of potassium permanganate is discharged, indicates the presence of oxalate.

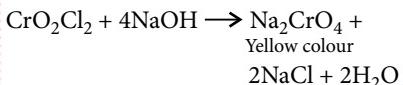


### Chloride ( $\text{Cl}^-$ )

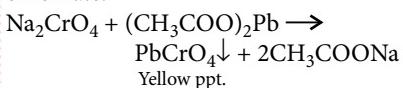
**Chromyl chloride test :** On heating salt with concentrated sulphuric acid in the presence of potassium dichromate, deep red vapours of chromyl chloride are evolved.



These vapours on passing through sodium hydroxide solution give yellow solution of sodium chromate.



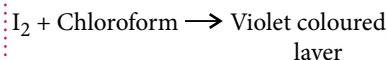
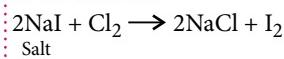
The yellow solution on neutralising with acetic acid and on addition of lead acetate gives yellow precipitate of lead chromate.



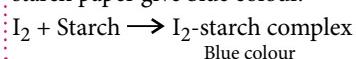
### Iodide ( $\text{I}^-$ )

**Layer test :** On treating salt with dilute sulphuric acid, chloroform or carbon tetrachloride and chlorine water, gives violet coloured layer.

Chlorine replaces iodine that dissolves in chloroform.



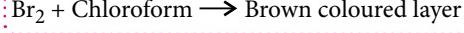
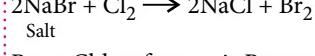
**Starch paper test :** Violet vapours with starch paper give blue colour.



### Confirmatory tests for acid radicals of group II

**Layer test :** On treating salt with dilute sulphuric acid, chloroform or carbon tetrachloride and chlorine water gives brown coloured layer.

Chlorine replaces bromine that dissolves in chloroform.



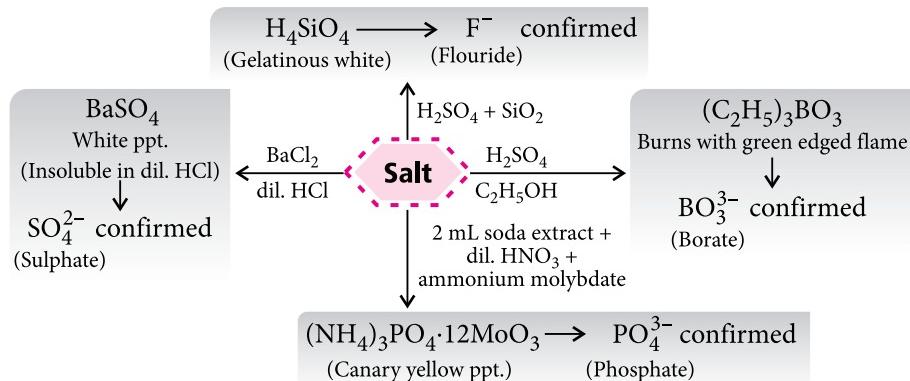
### Bromide ( $\text{Br}^-$ )



## New system to detect mercury in water systems!

A new ultra-sensitive, low-cost and portable system for detecting mercury in environmental water has been developed by University of Adelaide researchers. The researchers team has engineered a nanoporous material called nanoporous anodic alumina to make a special structure called a rugate filter. The surface of the filter has been modified to make it selective to mercury ions. As water flows through the pores of the filter, the mercury ions become attached to the surface. An optical system—reflection spectroscopy—measures the amount of mercury present. A range of tests have shown the sensor can detect mercury at levels of 200 parts per billion in a complex mixture of other metal ions and environmental samples. Continued work will seek to enhance the optical signals for even higher sensitivity. The promising sensing performance of this system along with its cost-competitiveness and portability make it an excellent potential alternative to current analytical techniques. This technique could provide the basis for future point-of-analysis systems for monitoring water quality on site and may help implement better monitoring processes around the world.

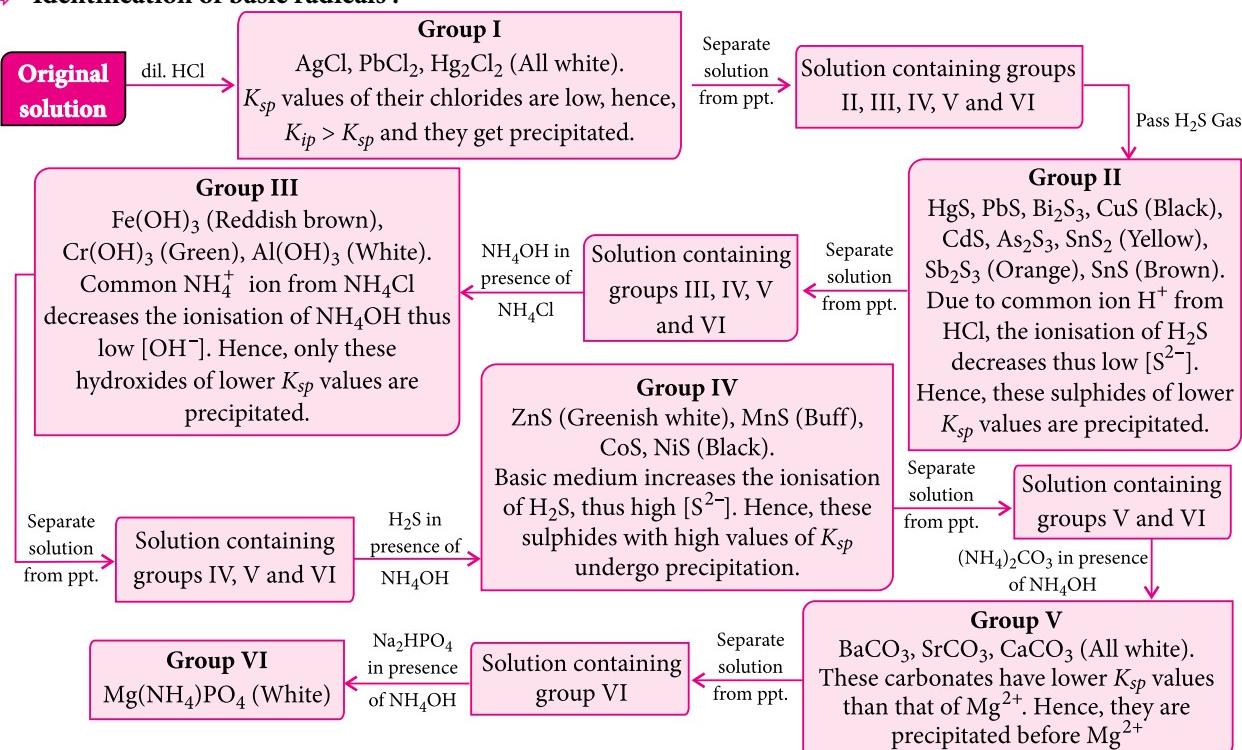
Third group : These radicals cannot be detected by either dil.  $H_2SO_4$  or conc.  $H_2SO_4$ . For detection of these acidic radicals we need some specific tests.



## CATIONS OR BASIC RADICALS

Group	Group reagent	Cations	Form of ppt.
I	dil. HCl	$Pb^{2+}, Ag^+, Hg_2^{2+}$	Chlorides
II	dil. HCl + $H_2S$ gas	$Pb^{2+}, Hg^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, Sb^{3+}, As^{3+}, Sn^{2+}/Sn^{4+}$	Sulphides
III	$NH_4Cl + NH_4OH$	$Fe^{3+}, Al^{3+}, Cr^{3+}$	Hydroxides
IV	$NH_4Cl + NH_4OH + H_2S$ gas	$Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}$	Sulphides
V	$(NH_4)_2CO_3 + NH_4OH$	$Ca^{2+}, Sr^{2+}, Ba^{2+}$	Carbonates
VI	$Na_2HPO_4 + NH_4OH$	$Mg^{2+}$	-

Identification of basic radicals :



☛ Confirmatory tests of basic radicals :

Precipitates	Confirmatory Tests
<b>Group I</b>	
AgCl	Dissolves in NH <sub>4</sub> OH, white ppt. of AgCl is again obtained on adding dil. HNO <sub>3</sub> . Yellow ppt. of AgI is formed on adding KI.
PbCl <sub>2</sub>	Dissolves in hot water, gives yellow ppt. of PbCrO <sub>4</sub> with K <sub>2</sub> CrO <sub>4</sub> and yellow ppt. of PbI <sub>2</sub> with KI.
Hg <sub>2</sub> Cl <sub>2</sub>	Turns black with NH <sub>4</sub> OH. Black residue {Hg + Hg(NH <sub>2</sub> )Cl} dissolves in aqua regia forming mercuric chloride (HgCl <sub>2</sub> ). On addition of stannous chloride solution to HgCl <sub>2</sub> white ppt. (Hg <sub>2</sub> Cl <sub>2</sub> ) is formed which turns grey (Hg).
<b>Group II A</b>	Precipitates do not dissolve in yellow ammonium sulphide.
HgS	Dissolves in aqua regia, grey ppt. of Hg is obtained with SnCl <sub>2</sub> or Cu turnings.
PbS	Dissolves in dil. HNO <sub>3</sub> , white ppt. of PbSO <sub>4</sub> is obtained on adding dil. H <sub>2</sub> SO <sub>4</sub> .
Bi <sub>2</sub> S <sub>3</sub>	Dissolves in dil. HCl, white ppt. of BiOCl is obtained on adding excess of water. Black ppt. of Bi is obtained on adding Na <sub>2</sub> SnO <sub>2</sub> solution.
CuS	Blue coloured solution is obtained on adding dil. HNO <sub>3</sub> and excess of NH <sub>4</sub> OH which gives chocolate brown ppt. of Cu <sub>2</sub> [Fe(CN) <sub>6</sub> ] with K <sub>4</sub> [Fe(CN) <sub>6</sub> ].
CdS	Colourless solution is obtained on adding dil. HNO <sub>3</sub> and excess of NH <sub>4</sub> OH, which gives yellow ppt. of CdS again on adding H <sub>2</sub> S.
<b>Group II B</b>	Precipitates dissolve in yellow ammonium sulphide.
As <sub>2</sub> S <sub>3</sub>	Insoluble sulphide, As <sub>2</sub> S <sub>5</sub> is obtained by treating with conc. HCl, which gives yellow ppt. of ammonium arsenomolybdate on adding conc. HNO <sub>3</sub> and heating with ammonium molybdate.
SnS <sub>2</sub> or SnS	Filtrate of sulphide in conc. HCl is reduced to SnCl <sub>2</sub> by treating with Fe or Zn which on adding HgCl <sub>2</sub> solution initially gives white ppt. of Hg <sub>2</sub> Cl <sub>2</sub> and finally turns to grey Hg.
Sb <sub>2</sub> S <sub>3</sub>	Filtrate of sulphide in conc. HCl gives white ppt. of SbOCl on adding excess of water and orange ppt. of Sb <sub>2</sub> S <sub>3</sub> on passing H <sub>2</sub> S gas.
<b>Group III</b>	
Fe(OH) <sub>3</sub>	Dissolves in dil. HCl, gives prussian blue solution or ppt. of Fe <sub>4</sub> [Fe(CN) <sub>6</sub> ] <sub>3</sub> on adding K <sub>4</sub> [Fe(CN) <sub>6</sub> ] and blood red coloured Fe(CNS) <sub>3</sub> on adding KCNS.
Cr(OH) <sub>3</sub>	The solution obtained on heating precipitate with NaOH and Br <sub>2</sub> water contains Na <sub>2</sub> CrO <sub>4</sub> which gives yellow ppt. of PbCrO <sub>4</sub> on treating with acidified lead acetate solution.
Al(OH) <sub>3</sub>	Dissolves in NaOH and is again precipitated out on boiling with NH <sub>4</sub> Cl.
<b>Group IV</b>	Soluble in conc. HCl.
ZnS	Solution (ZnCl <sub>2</sub> ) is treated with NaOH, a white ppt. of Zn(OH) <sub>2</sub> appears which dissolves in excess of NaOH and on passing H <sub>2</sub> S, white ppt. of ZnS is obtained.
MnS	Precipitate of MnO <sub>2</sub> is obtained on heating the solution with NaOH and Br <sub>2</sub> water. HMnO <sub>4</sub> imparts pink colour to the supernatant liquid on treating the ppt. with excess of HNO <sub>3</sub> and red lead (Pb <sub>3</sub> O <sub>4</sub> ).
<b>Group IV</b>	Insoluble in conc. HCl
CoS	Dissolves in aqua-regia. Yellow ppt. of potassium cobaltinitrite K <sub>3</sub> [Co(NO <sub>2</sub> ) <sub>6</sub> ] is obtained on adding CH <sub>3</sub> COOH (in excess) and KNO <sub>2</sub> .
NiS	Dissolves in aqua-regia. Red ppt. of Ni-dmg complex is obtained on adding NH <sub>4</sub> OH in excess and dimethyl glyoxime.

<b>Group V</b>	Soluble in acetic acid.
BaCO <sub>3</sub>	Yellow ppt. of BaCrO <sub>4</sub> is obtained on adding K <sub>2</sub> CrO <sub>4</sub> to solution.
SrCO <sub>3</sub>	White ppt. of SrSO <sub>4</sub> is obtained on adding (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> to solution.
CaCO <sub>3</sub>	White ppt. of CaC <sub>2</sub> O <sub>4</sub> is obtained on adding (NH <sub>4</sub> ) <sub>2</sub> C <sub>2</sub> O <sub>4</sub> to solution.
<b>Group VI</b>	
Mg <sup>2+</sup>	White ppt. of Mg(NH <sub>4</sub> )PO <sub>4</sub> is formed on adding Na <sub>2</sub> HPO <sub>4</sub> and NH <sub>4</sub> OH to solution.
<b>Zero</b>	
NH <sub>4</sub> <sup>+</sup>	Salt evolves NH <sub>3</sub> gas on heating with NaOH which gives dense white fumes of NH <sub>4</sub> Cl with HCl and a brown ppt. of H <sub>2</sub> N·HgO·HgI on adding Nessler's reagent, K <sub>2</sub> HgI <sub>4</sub> .

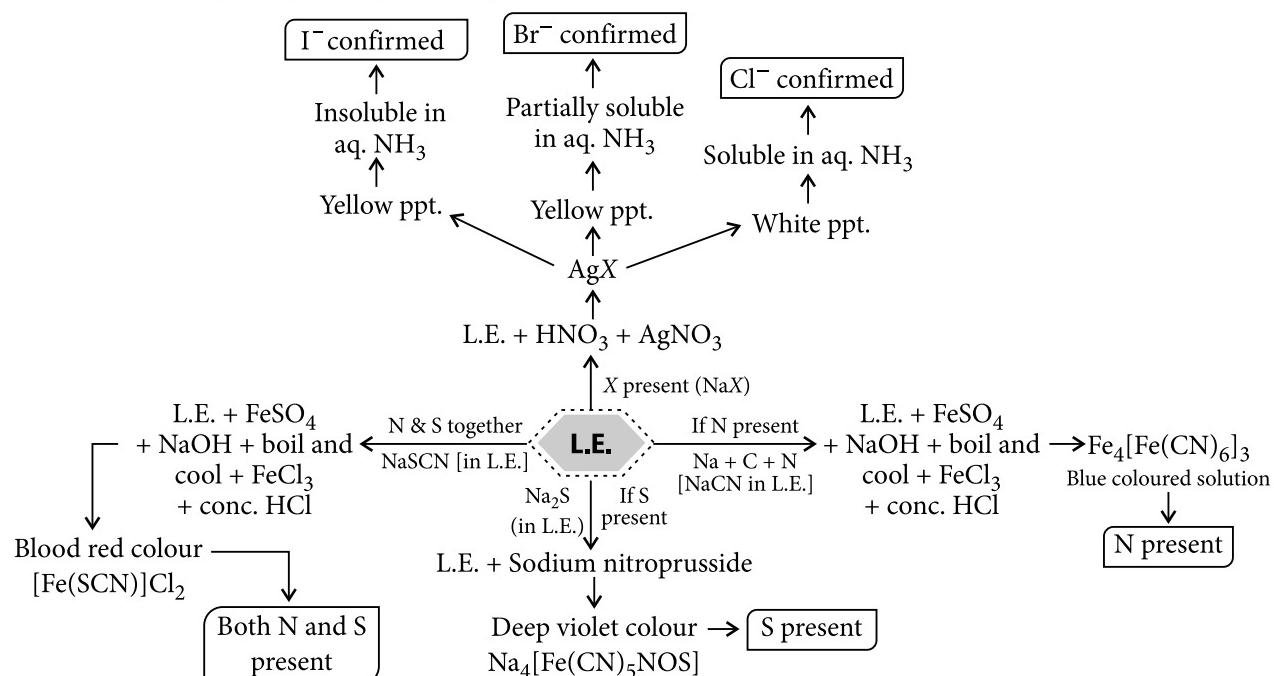
## DETECTION OF N, S, CI IN ORGANIC COMPOUNDS

### LASSAIGNE'S TEST

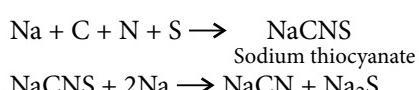
It is a general test for the detection of halogen, nitrogen and sulphur in organic compounds. These elements are covalently bonded to the organic compounds. In order to detect them, these have to be converted into their ionic forms. This is done by fusing the organic compound with

sodium metal. The ionic compounds formed during the fusion are extracted in aqueous solution and can be detected by simple chemical tests.

**Lassaigne's extract :** A small pellet of metallic sodium together with a little amount of the substance is heated to red hot in an ignition tube. It is then suddenly plunged into about 10 mL of distilled water in a China dish. The mixture is boiled well and filtered. Filtrate is known as Lassaigne's extract (L.E.).



When sodium fusion is carried out with excess of sodium, thiocyanate decomposes to cyanide and sulphide ions which give their usual tests. Thus, we do not get blood red colour with ferric chloride even though N and S both are present.



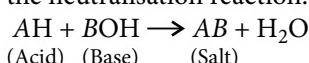
Lassaigne's test fails in case of compounds which contain nitrogen but no carbon e.g., hydrazine (NH<sub>2</sub>NH<sub>2</sub>) and hydroxylamine (NH<sub>2</sub>OH).

## TITRATION

One of the important methods in quantitative analysis is volumetric analysis, a commonly used laboratory technique. It is used to determine the unknown concentration of a sample by measuring its volume.

### ACID BASE TITRATION

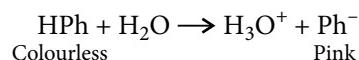
- It is a method used to determine the strength of an acid or alkali and this type of titration is based on the neutralisation reaction.



### INDICATOR

- An indicator is a chemical substance that undergoes a colour change at the end point. The end point of an acid-base titration can be determined using acid-base indicators. Acid base indicators are either weak organic acids or weak organic bases. The colour change of an indicator depends on the pH of the medium. The un-ionized form of an indicator has one colour, but its ionized form has a different colour.

For example, consider the indicator phenolphthalein, whose ionization can be written as :



- Some common examples of acid-base indicators :

Indicators	pH Range	Acid	Base
Phenolphthalein	8.0 - 10.0	Colourless	Pink
Methyl orange	3.1 - 4.4	Red	Orange
Methyl red	4.4 - 6.2	Red	Yellow
Phenol red	6.4 - 8.0	Yellow	Red
Thymol blue	1.2 - 2.8	Red	Yellow
Thymol blue	8.0 - 9.6	Yellow	Blue
Methyl yellow	2.9 - 4.0	Red	Yellow

### TITRIMETRIC CALCULATIONS

- Strength of a solution :** It is the amount of solute in grams present per litre of the solution.
- Strength (g/L) = Normality × Eq. wt.
  - Strength (g/L) = Molarity × Mol. mass
- Normality equation :**  $N_1 V_1 = N_2 V_2$   
(Solution 1) (Solution 2)
- Molarity equation :**  $M_1 V_1 n_1 = M_2 V_2 n_2$   
(Solution 1) (Solution 2)  
[ $\because N = M \times n$ , where  $n$  = valency factor]

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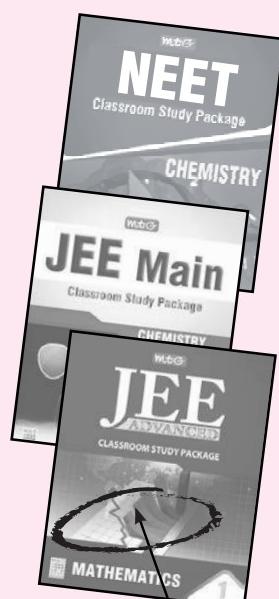
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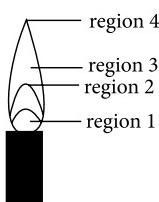
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# SPEED PRACTICE

1. To a solution of an acid radical,  $MgSO_4$  solution is added and white ppt. appears only on heating. The acid radical may be  
 (a)  $CO_3^{2-}$  (b)  $SO_3^{2-}$  (c)  $HCO_3^-$  (d)  $C_2O_4^{2-}$
  2. In second group,  $H_2S$  is passed in the presence of dil. HCl because  
 (a) HCl checks incomplete precipitation of higher group radicals  
 (b) HCl checks precipitation of sulphur  
 (c) both (a) and (b)  
 (d) none of the above.
  3. During the titration of  $CH_3COOH$  with NaOH, the pH at the end point is likely to be  
 (a) less than 7 (b) more than 7  
 (c) equal to 7  
 (d) depends upon molarity of NaOH.
  4. An aqueous solution of a salt gave white precipitate on treatment with dilute HCl. The precipitate dissolved in boiling water. Both the solutions give white precipitate with dilute  $H_2SO_4$  and yellow precipitate with  $K_2CrO_4$  and KI separately. The metal ion present in the solution is  
 (a) Hg(II) (b) Hg(I) (c) Pb(II) (d) Cu (II)
  5. Potassium chromate solution is added to an aqueous solution of a metal chloride. The precipitate thus obtained is insoluble in acetic acid. This is subjected to flame test, the colour of the flame is  
 (a) lilac (b) apple green  
 (c) crimson red (d) golden yellow.
  6. An aqueous solution of 6.3 g oxalic acid dihydrate is made up to 250 mL. The volume of 0.1 N NaOH required to completely neutralise 10 mL of this solution is  
 (a) 40 mL (b) 20 mL (c) 10 mL (d) 4 mL
  7. Which one of the following statements is correct when  $SO_2$  is passed through acidified  $K_2Cr_2O_7$  solution?  
 (a)  $SO_2$  is reduced.  
 (b) Green  $Cr_2(SO_4)_3$  is formed.  
 (c) The solution turns blue.  
 (d) The solution is decolourised.
  8. In the separation of  $Cu^{2+}$  and  $Cd^{2+}$  in 2<sup>nd</sup> group qualitative analysis of cations, tetrammine copper(II) sulphate and tetramminecadmium(II) sulphate react with KCN to form the corresponding cyano complexes. Which one of the following pairs of the complexes and their relative stability enable the separation of  $Cu^{2+}$  and  $Cd^{2+}$ ?  
 (a)  $K_3[Cu(CN)_4]$  more stable and  $K_2[Cd(CN)_4]$  less stable.  
 (b)  $K_2[Cu(CN)_4]$  less stable and  $K_2[Cd(CN)_4]$  more stable.  
 (c)  $K_2[Cu(CN)_4]$  more stable and  $K_2[Cd(CN)_4]$  less stable.  
 (d)  $K_3[Cu(CN)_4]$  less stable and  $K_2[Cd(CN)_4]$  more stable.
  9. 0.45 g of acid (molecular weight 90) is neutralised by 20 mL of 0.5 N caustic potash. The basicity of acid is  
 (a) 1 (b) 2 (c) 3 (d) 4
  10. 35.4 mL of HCl is required for the neutralisation of a solution containing 0.275 g of sodium hydroxide. The normality of hydrochloric acid is  
 (a) 0.97 N (b) 0.142 N  
 (c) 0.194 N (d) 0.244 N
  11. The reagent(s) that can selectively precipitate  $S^{2-}$  from a mixture of  $S^{2-}$  and  $SO_4^{2-}$  in aqueous solution is (are)  
 (a)  $CuCl_2$  (b)  $BaCl_2$   
 (c)  $Pb(OOCCH_3)_2$  (d)  $Na_2[Fe(CN)_5NO]$
- (JEE Advanced 2016)**
12. Two solutions of HCl, A and B have concentrations of 0.5 N and 0.1 N respectively. The volume of solutions A and B required to make 2 litre of 0.2 N HCl are  
 (a) 0.5 L of A and 1.5 L of B  
 (b) 1.5 L of A and 0.5 L of B  
 (c) 1.0 L of A and 1.0 L of B  
 (d) 0.75 L of A and 1.25 L of B.
  13. In group IV analysis  $NH_4OH$  is added before passing  $H_2S$  gas because  
 (a) the sulphides of group IV are insoluble in  $NH_4OH$   
 (b) the sulphides of other metals are soluble in  $NH_4OH$

**(NEET Phase-I 2016)**

- (c) the concentration of  $S^{2-}$  ions is high enough to precipitate the sulphides of group IV  
 (d) the sulphides of second group are soluble in  $NH_4OH$ .
- 14.** A solution of a metal ion when treated with KI gives a red precipitate which dissolves in excess of KI to give a colourless solution. Moreover, the solution of metal ion on treatment with a solution of cobalt(II) thiocyanate gives rise to deep blue crystalline precipitate. The metal ion is  
 (a)  $Pb^{2+}$  (b)  $Hg^{2+}$  (c)  $Cu^{2+}$  (d)  $Co^{2+}$
- 15.** In the following reaction sequence in aqueous solution, the species X, Y and Z, respectively are
- $$S_2O_3^{2-} \xrightarrow{Ag^+} X \xrightarrow{Ag^+} Y \xrightarrow{\text{With time}} Z$$
- Clear solution      White precipitate      Black precipitate
- (a)  $[Ag(S_2O_3)_2]^{3-}$ ,  $Ag_2S_2O_3$ ,  $Ag_2S$   
 (b)  $[Ag(S_2O_3)_3]^{5-}$ ,  $Ag_2SO_3$ ,  $Ag_2S$   
 (c)  $[Ag(SO_3)_2]^{3-}$ ,  $Ag_2S_2O_3$ ,  $Ag$   
 (d)  $[Ag(SO_3)_3]^{3-}$ ,  $Ag_2SO_4$ ,  $Ag$
- (JEE Advanced 2016)**
- 16.** Lassaigne's test for nitrogen is positive for which compound?  
 (a)  $NH_2OH$       (b)  $NH_2NH_2$   
 (c)  $H_2NCONH_2$       (d) All of these
- 17.** When intimate mixture of potassium dichromate and KCl is heated with conc.  $H_2SO_4$ , which of the following is produced in the form of red vapours?  
 (a)  $CrO_3$       (b)  $Cr_2O_3$   
 (c)  $CrO_2Cl_2$       (d)  $CrCl_3$
- 18.** A laboratory reagent on strongly heating gives two oxides of sulphur. On addition of aq. NaOH solution to its aqueous solution a dirty green precipitate is obtained. Identify the reagent.  
 (a)  $FeSO_4$       (b)  $CuSO_4$   
 (c)  $Al_2(SO_4)_3$       (d) None of these
- 19.** 25 mL of a solution of barium hydroxide on titration with a 0.1 molar solution of hydrochloric acid gave a titre value of 35 mL. The molarity of barium hydroxide solution was  
 (a) 0.14 M (b) 0.28 M (c) 0.35 M (d) 0.07 M
- 20.** The hottest region of Bunsen flame shown in the figure below is
- 
- (a) region 1      (b) region 2  
 (c) region 3      (d) region 4.
- (JEE Main 2016)**
- 21.**  $Cl_2$  gas is continuously passed with constant shaking through Lassaigne's extract containing  $CS_2$ . If the extract contains both  $NaBr$  and  $NaI$ , first a violet colour is produced, then the organic layer turns colourless and finally orange colour is seen in the  $CS_2$  layer. The  $CS_2$  turns colourless between violet and orange colour due to the formation of  
 (a)  $IBr$       (b)  $ICl$       (c)  $BrCl_3$       (d)  $NaI_3$
- 22.** A solution containing  $Na_2CO_3$  and  $NaHCO_3$  is titrated against HCl. The volume of the acid used when methyl orange is added as indicator is ' $x$ ' mL and the volume of the acid used when phenolphthalein is added as indicator separately is ' $y$ ' mL. The volume of HCl used for the neutralisation of  $NaHCO_3$  will be  
 (a)  $(x - y)$  mL      (b)  $(x - 2y)$  mL  
 (c)  $(x + y)$  mL      (d)  $(x + 2y)$  mL
- 23.** In the titration of sodium carbonate with hydrochloric acid taken in burette the indicator used is  
 (a) phenolphthalein for first equivalence point and methyl orange for second equivalence point  
 (b) methyl orange for first equivalence point and phenolphthalein for second equivalence point  
 (c) either methyl orange or phenolphthalein for both equivalence points  
 (d) thymol blue for both equivalence points.
- 24.** A blue colouration is not obtained when  
 (a) ammonium hydroxide dissolves in copper sulphate  
 (b) copper sulphate solution reacts with  $K_4[Fe(CN)_6]$   
 (c) ferric chloride reacts with sodium ferrocyanide  
 (d) anhydrous white  $CuSO_4$  is dissolved in water.
- 25.** Sodium extract is heated with concentrated  $HNO_3$  before testing for halogens because  
 (a)  $Ag_2S$  and  $AgCN$  are soluble in acidic medium  
 (b) silver halides are totally insoluble in nitric acid  
 (c)  $S^{2-}$  and  $CN^-$ , if present, are decomposed by conc.  $HNO_3$  and hence, do not interfere in the test  
 (d) Ag reacts faster with halides in acidic medium.
- (JEE Main 2016 online)**
- 26.** Which of the following statements is wrong?  
 (a) Using Lassaigne's test, nitrogen and sulphur present in an organic compound can be tested.

- (b) Using Beilstein's test, the presence of halogens in a compound can be tested.

(c) In Lassaigne's filtrate, the nitrogen in an organic compound is converted to NaCN.

(d) In the estimation of carbon, an organic compound is heated with CaO in a combustion tube.

**27.** The brown ring test for nitrates depends on

  - (a) the reduction of nitrate to nitric oxide
  - (b) oxidation of nitric oxide to nitrogen dioxide
  - (c) reduction of ferrous sulphate to iron
  - (d) oxidising action of sulphuric acid.

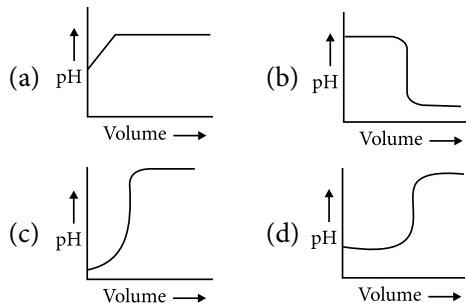
**28.** The following four solutions are kept in separate beakers and copper metal is put in each of them. Which solution will become blue after sometime ?

  - (a)  $\text{AgNO}_3$  solution
  - (b)  $\text{Zn}(\text{NO}_3)_2$  solution
  - (c)  $\text{Ba}(\text{NO}_3)_2$  solution
  - (d)  $\text{NaNO}_3$  solution

**29.** An aqueous solution of  $\text{FeSO}_4$ ,  $\text{Al}_2(\text{SO}_4)_3$  and chrome alum is heated with excess of  $\text{Na}_2\text{O}_2$  and filtered. The materials obtained are

  - (a) a colourless filtrate and a green residue
  - (b) a yellow filtrate and a green residue
  - (c) a yellow filtrate and a brown residue
  - (d) a green filtrate and a brown residue.

**30.** Which of the following plots represents the graph of pH against volume of alkali added in titration of NaOH and HCl ?



SOLUTIONS

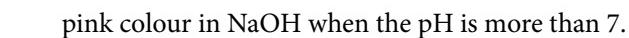
- 1. (c):**  $2\text{NaHCO}_3 + \text{MgSO}_4 \longrightarrow \text{Mg}(\text{HCO}_3)_2 + \text{Na}_2\text{SO}_4$   
Soluble

$$\text{Mg}(\text{HCO}_3)_2 \xrightarrow{\Delta} \text{MgCO}_3 + \text{H}_2\text{O} + \text{CO}_2$$

White ppt.

**2. (a):** Due to common ion effect, the ionisation of  $\text{H}_2\text{S}$  is suppressed by  $\text{HCl}$  and only group II basic radicals are precipitated. Higher groups are not precipitated.

**3. (b):** In the titration of  $\text{CH}_3\text{COOH}$  with  $\text{NaOH}$ , phenolphthalein is used as an indicator. It gives





# MPP | MONTHLY Practice Paper

Class XI

This specially designed column enables students to self analyse their extent of understanding of complete syllabus. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.



Total Marks : 120

Time Taken : 60 Min.

## NEET / AIIMS

### Only One Option Correct Type

- 1.12 mL of a gas X is produced at STP by the action of 2.3 mg of an alcohol with methyl magnesium iodide. The molecular mass of alcohol and the gas X are respectively  
 (a) 32 ; CH<sub>4</sub>      (b) 46 ; CH<sub>4</sub>  
 (c) 46 ; C<sub>2</sub>H<sub>6</sub>      (d) none of these.
2. The wave number of electromagnetic radiations emitted during the transition in between two energy levels of Li<sup>2+</sup> ion whose principal quantum number sum is 4 and difference is 2, is  
 (a) 3.5 R<sub>H</sub>    (b) 4 R<sub>H</sub>    (c) 8 R<sub>H</sub>    (d)  $\frac{8}{9} R_H$
3. The root mean square velocity of a gas molecule at 100 K and 0.5 atm pressure is 106.4 m s<sup>-1</sup>. If the temperature is raised to 400 K and the pressure is raised to 2 atm, the root mean square velocity becomes  
 (a) 106.4 m s<sup>-1</sup>      (b) 425.6 m s<sup>-1</sup>  
 (c) 212.8 m s<sup>-1</sup>      (d) 851.2 m s<sup>-1</sup>
4. What will be the heat of formation of methane if the heat of combustion of carbon is ' $-x$ ' kJ, heat of formation of water is ' $-y$ ' kJ and heat of combustion of methane is ' $-z$ ' kJ?  
 (a)  $(-x - y + z)$  kJ      (b)  $(-z - x + 2y)$  kJ  
 (c)  $(-x - 2y - z)$  kJ      (d)  $(-x - 2y + z)$  kJ
5. ' $a$ ' moles of PCl<sub>5</sub> is heated in a closed container to equilibriate PCl<sub>5(g)</sub> ⇌ PCl<sub>3(g)</sub> + Cl<sub>2(g)</sub> at a pressure of  $P$  atm. If ' $x$ ' moles of PCl<sub>5</sub> dissociate at equilibrium, then  

$$(a) \frac{x}{a} = \frac{K_p}{K_p + P}$$

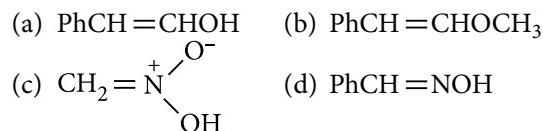
$$(b) \frac{x}{a} = \left( \frac{K_p + P}{K_p} \right)^{1/2}$$

$$(c) \frac{x}{a} = \left( \frac{K_p}{P} \right)^{1/2}$$

$$(d) \frac{x}{a} = \left( \frac{K_p}{K_p + P} \right)^{1/2}$$
6. In a polar molecule, the ionic charge is  $4.8 \times 10^{-10}$  e.s.u. If the interionic distance is 1 Å, then the dipole moment is  
 (a) 41.8 debye      (b) 4.18 debye  
 (c) 4.8 debye      (d) 0.48 debye
7. If the collision frequency of a gas at 1 atm pressure is  $Z$ , then its collision frequency at 0.5 atm is  
 (a)  $1.0 Z$     (b)  $0.25 Z$     (c)  $2 Z$     (d)  $0.50 Z$
8. If  $M$  is the molecular weight of FeC<sub>2</sub>O<sub>4</sub>, then its equivalent weight in the conversion, FeC<sub>2</sub>O<sub>4</sub> → Fe<sup>3+</sup> + CO<sub>2</sub> is  
 (a)  $\frac{M}{3}$       (b)  $\frac{M}{6}$   
 (c)  $\frac{M}{2}$       (d) equal to  $M$ .
9. The volume of 0.05 M KMnO<sub>4</sub> solution required to oxidise completely 2.70 g of oxalic acid (H<sub>2</sub>C<sub>2</sub>O<sub>4</sub>) in acidic medium will be  
 (a) 120 cm<sup>3</sup>      (b) 240 cm<sup>3</sup>  
 (c) 360 cm<sup>3</sup>      (d) 480 cm<sup>3</sup>
10. Which one of the following is present as an active ingredient in bleaching powder for bleaching action?  
 (a) CaOCl<sub>2</sub>      (b) Ca(OCl)<sub>2</sub>  
 (c) CaO<sub>2</sub>Cl      (d) CaCl<sub>2</sub>

- 11.** The correct order of decreasing ionic character of lead dihalides is :
- $\text{PbF}_2 > \text{PbCl}_2 > \text{PbBr}_2 > \text{PbI}_2$
  - $\text{PbF}_2 > \text{PbBr}_2 > \text{PbCl}_2 > \text{PbI}_2$
  - $\text{PbF}_2 > \text{PbI}_2 > \text{PbCl}_2 > \text{PbBr}_2$
  - $\text{PbCl}_2 > \text{PbBr}_2 > \text{PbF}_2 > \text{PbI}_2$

- 12.** The compound which will not show tautomerism is



#### Assertion and Reason Type

**Directions :** In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :

- If both assertion and reason are true and reason is the correct explanation of assertion.
- If both assertion and reason are true but reason is not the correct explanation of assertion.
- If assertion is true but reason is false.
- If both assertion and reason are false.

- 13. Assertion :**  $\text{CH}_4$  does not react with  $\text{Cl}_2$  in dark.

**Reason :** Chlorination of  $\text{CH}_4$  takes place in sunlight.

- 14. Assertion :** Suspended particulate matter (SPM) is an important pollutant released by diesel vehicles.

**Reason :** Catalytic converters greatly reduce pollution caused by automobiles.

- 15. Assertion :** Absolute ethanol cannot be obtained by simple fractional distillation of a mixture of alcohol and water.

**Reason :** The absolute alcohol boils at  $78.3^\circ\text{C}$ .

#### JEE MAIN / JEE ADVANCED / PETs

#### Only One Option Correct Type

- 16.** The electron affinity values (in  $\text{kJ mol}^{-1}$ ) of three halogens  $X$ ,  $Y$  and  $Z$  are respectively  $-349$ ,  $-333$  and  $-325$ . Then  $X$ ,  $Y$  and  $Z$  are respectively
- $\text{F}_2$ ,  $\text{Cl}_2$  and  $\text{Br}_2$
  - $\text{Cl}_2$ ,  $\text{F}_2$  and  $\text{Br}_2$
  - $\text{Cl}_2$ ,  $\text{Br}_2$  and  $\text{F}_2$
  - $\text{Br}_2$ ,  $\text{Cl}_2$  and  $\text{F}_2$

- 17.** The number of nodal planes present in  $\sigma^*s$ -orbital is

- 0
- 3
- 1
- 2

- 18.** The ionisation enthalpies of lithium and sodium are  $520 \text{ kJ mol}^{-1}$  and  $495 \text{ kJ mol}^{-1}$  respectively. The

energies required to convert all the atoms present in  $7 \text{ mg}$  of lithium vapours and  $23 \text{ mg}$  of sodium vapours to their respective gaseous cations respectively are

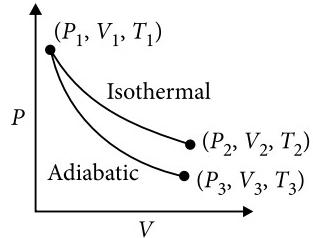
- $52 \text{ J}, 49.5 \text{ J}$
- $520 \text{ J}, 495 \text{ J}$
- $49.5 \text{ J}, 52 \text{ J}$
- $495 \text{ J}, 520 \text{ J}$

- 19.** An ideal gas has a volume  $V$  at temperature  $T$ . During a change, it follows an additional law  $VP^2 = \text{constant}$ . The final temperature of the gas when it expands to a volume  $2V$  will be

- $2T$
- $\sqrt{2}T$
- $1.5T$
- $2.5T$

#### More than One Options Correct Type

- 20.** The reversible expansion of an ideal gas under adiabatic and isothermal conditions is shown in the figure. Which of the following statement(s) is (are) correct?



- $T_1 = T_2$
- $T_3 > T_1$
- $w_{\text{isothermal}} > w_{\text{adiabatic}}$
- $\Delta U_{\text{isothermal}} > \Delta U_{\text{adiabatic}}$

- 21.** Which of the following statements are not correct?

- $K_w$  is always constant and equal to  $10^{-14}$ .
- $\text{pH} + \text{pOH} = \text{p}K_w$  at all temperatures.
- Salts of weak acid and weak base do not undergo hydrolysis.
- Addition of sodium acetate to acetic acid increases the pH of acetic acid.

- 22.** In an exothermic reaction, heat is evolved, and system loses heat to the surroundings. For such system

- $q_p$  will be negative
- $\Delta_r H$  will be negative
- $q_p$  will be positive
- $\Delta_r H$  will be positive.

- 23.** Examine the following two structures for the anilinium ion and choose the incorrect statements.



- (a) II is not an acceptable canonical structure because carbonium ions are less stable than ammonium ions.
- (b) II is not an acceptable canonical structure because it is non-aromatic.
- (c) II is not an acceptable canonical structure because nitrogen has 10 valence electrons.
- (d) II is an acceptable canonical structure.

#### Integer Answer Type

24. How many of the following compounds are used as stabilizers for  $\text{H}_2\text{O}_2$  to check its decomposition?  
 $\text{K}_2\text{O}$ ,  $\text{H}_3\text{PO}_4$ , glycerol,  $\text{Na}_2\text{O}$ , alcohol, acetanilide

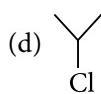
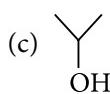
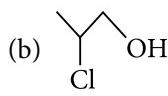
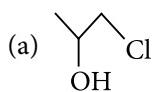
25. The number of alkali metals existing as liquid at 303 K is  
 Li, Na, K, Rb, Cs, Fr

26. When Sn (IV) chloride is treated with excess of conc. HCl, the complex  $[\text{SnCl}_6]^{2-}$  is formed. The oxidation state of Sn in the complex is

#### Comprehension Type

Alkenes and alkynes undergo electrophilic addition reactions but alkynes are less reactive than alkenes in these reactions even though they contain two  $\pi$ -bonds. Although the addition of unsymmetrical reagents to unsymmetrical alkenes and alkynes generally occurs in accordance with Markovnikov's rule, yet there are many exceptions.

27. Propene on reaction with chlorine water gives



28. Addition of HCl to 3, 3, 3-trichloropropene gives  
 (a)  $\text{Cl}_3\text{CCH}_2\text{CH}_2\text{Cl}$       (b)  $\text{Cl}_3\text{CCHClCH}_3$   
 (c)  $\text{Cl}_2\text{CHCHClCH}_2\text{Cl}$       (d)  $\text{Cl}_2\text{CHCH}_2\text{CHCl}_2$

#### Matrix Match Type

29. Match the terms given in Column I with the compounds given in Column II.

Column I	Column II
(A) Acid rain	(P) $\text{CHCl}_2\text{CHF}_2$
(B) Photochemical smog	(Q) CO
(C) Combination with haemoglobin	(R) $\text{CO}_2$
(D) Depletion of ozone layer	(S) $\text{NO}_2$
	(T) Unsaturated hydrocarbons

A	B	C	D
(a) Q	P	R, S	S, T
(b) R, S	S, T	Q	P
(c) R, S	Q	P	S, T
(d) S, T	R, S	Q	P

30. Match the terms given in Column I with the compounds given in Column II.

Column I	Column II
(A) Entropy of vapourisation	(P) decreases
(B) K for spontaneous process	(Q) is always positive
(C) Crystalline solid state	(R) Lowest entropy
(D) $\Delta U$ in adiabatic expansion	(S) $\frac{\Delta H_{\text{vap}}}{T_b}$ of ideal gas

A	B	C	D
(a) P	Q	R	Q, S
(b) P	R	Q	Q, S
(c) Q, S	Q	P	R
(d) Q, S	Q	R	P

Keys are published in this issue. Search now! ☺

## SELF CHECK

#### Check your score! If your score is

No. of questions attempted .....  
 No. of questions correct .....  
 Marks scored in percentage .....

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.

# NEET | JEE ESSENTIALS

Class  
XII

Maximize your chance of success, and high rank in NEET, JEE (Main and Advanced) by reading this column. This specially designed column is updated year after year by a panel of highly qualified teaching experts well-tuned to the requirements of these Entrance Tests.

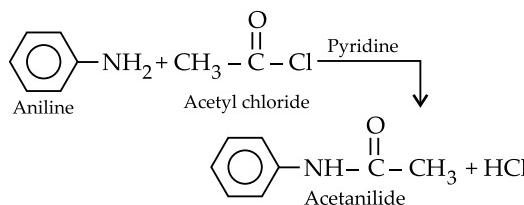
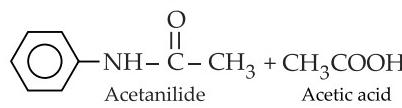
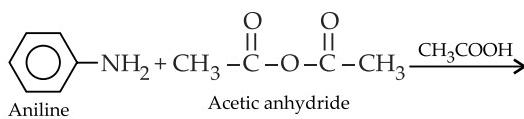
## Unit 9

## PRINCIPLES RELATED TO PRACTICAL CHEMISTRY

### ORGANIC COMPOUNDS

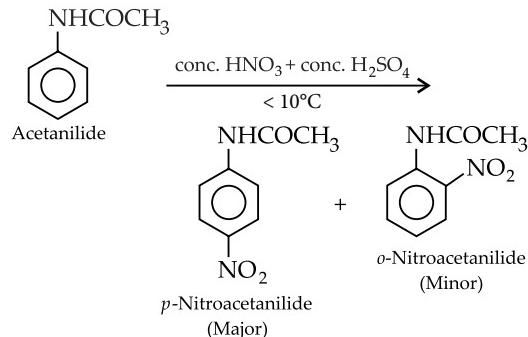
#### PREPARATION

- ☛ **Acetanilide :** It is an acetyl derivative of aniline.
- It is prepared by acetylation of aniline.



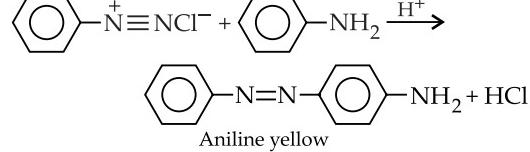
- It is a nucleophilic acyl substitution reaction in which aniline acts as a nucleophile and acetic anhydride acts as an electrophile.

- ☛ ***p*-Nitroacetanilide :** It is a nitro derivative of acetanilide.
- It is prepared by nitration of acetanilide with nitrating mixture.



- It is an electrophilic substitution reaction in which acetanilide acts as nucleophile and nitronium ion acts as an electrophile.

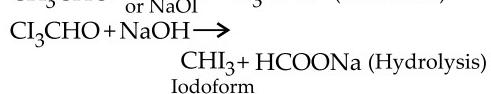
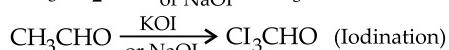
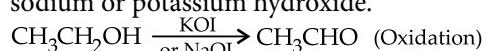
- ☛ **Aniline yellow :** It is an azo dye also known as *p*-aminoazobenzene.
- It is prepared by coupling of benzenediazonium chloride with aniline in acidic medium.



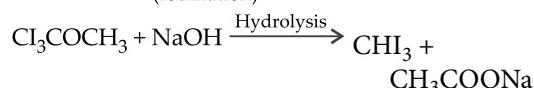
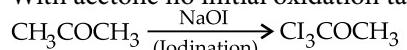
- ☛ **Iodoform :** It is triiodomethane and is an iodine analogue of chloroform. It is used as a mild antiseptic and disinfectant.

- It is prepared by treating an organic compound containing  $\text{CH}_3-\overset{\text{OH}}{\underset{|}{\text{CH}}}-$  group (ethanol,

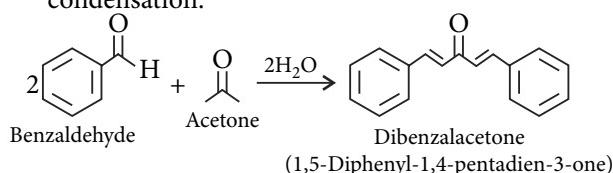
propan-2-ol, butan-2-ol) or  $\text{CH}_3-\overset{\text{O}}{\underset{\parallel}{\text{C}}}-$  group (acetaldehyde, acetone, butan-2-one, acetophenone) with iodine in presence of sodium or potassium hydroxide.



- With acetone no initial oxidation takes place.

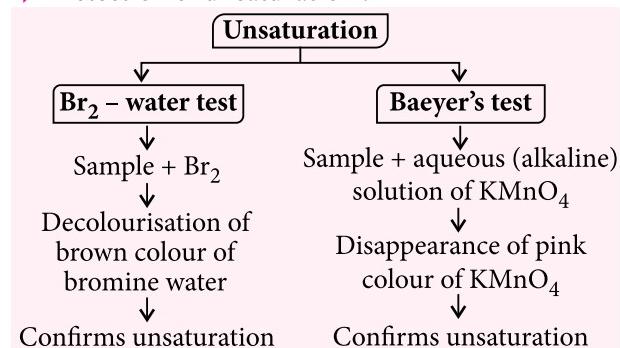


**Dibenzalacetone :** Dibenzalacetone is prepared by aldol condensation of acetone with two equivalents of benzaldehyde. It is a base catalysed aldol condensation.

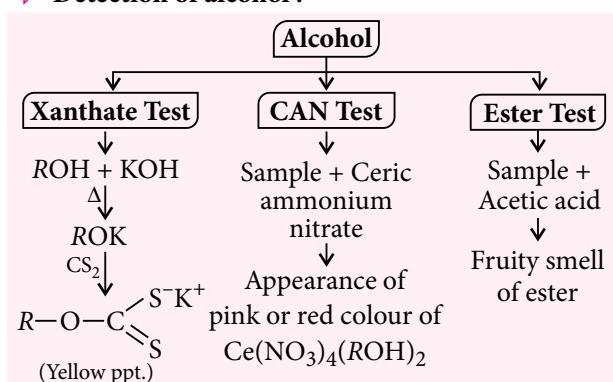


## DETECTION OF FUNCTIONAL GROUPS

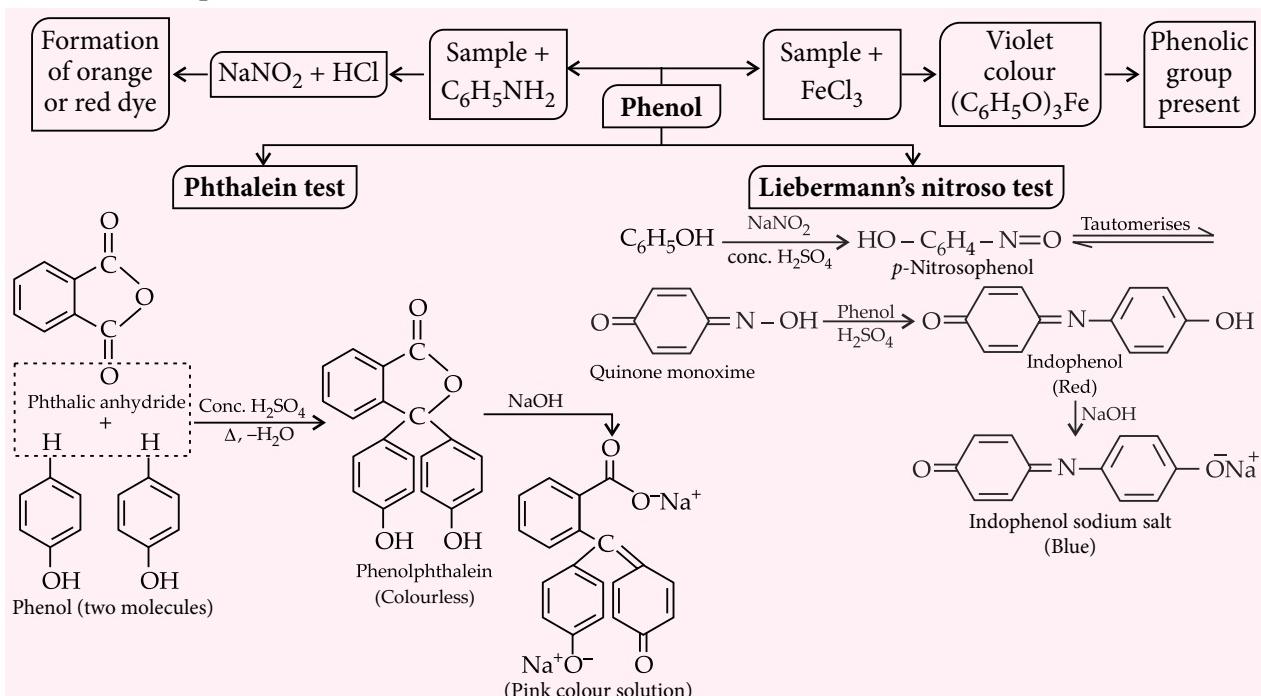
### Detection of unsaturation :



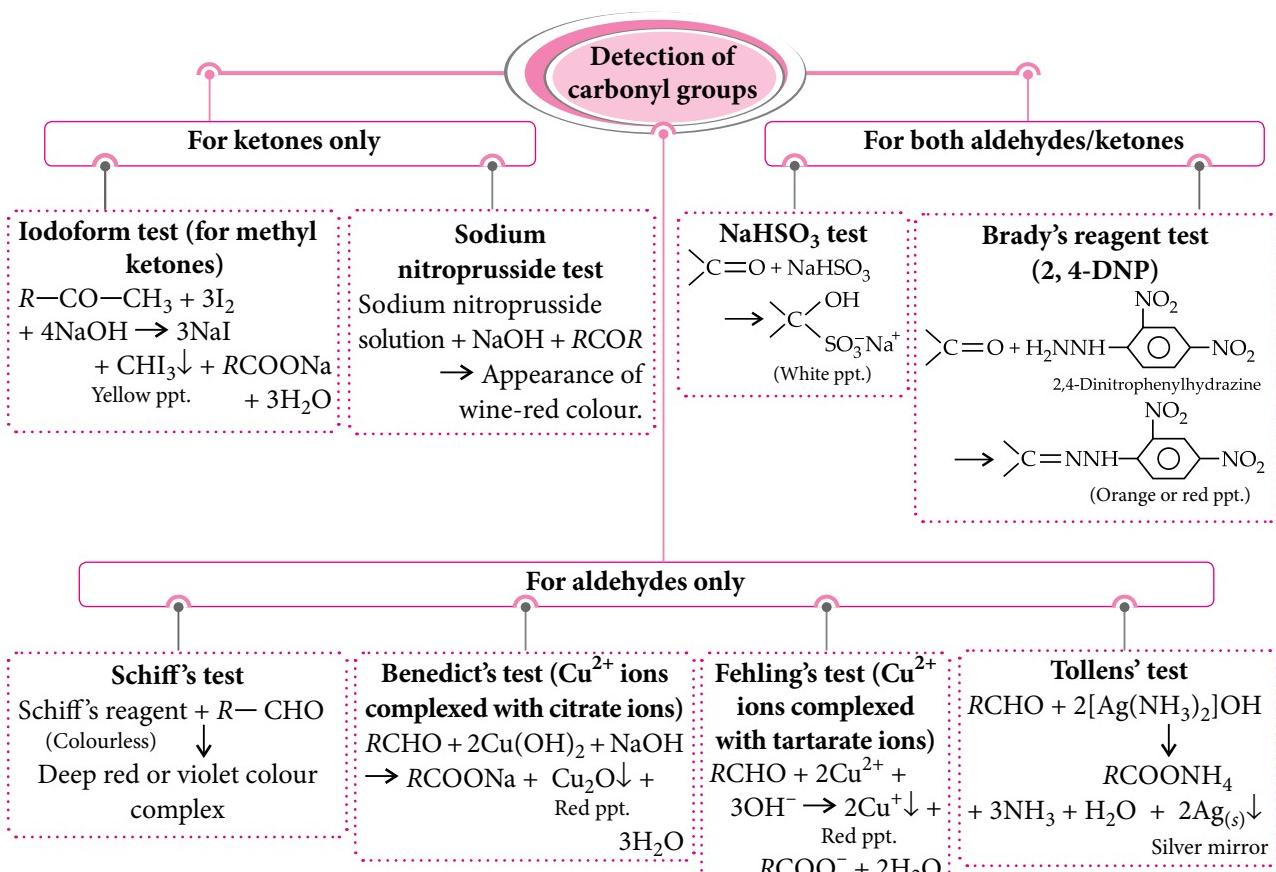
### Detection of alcohol :



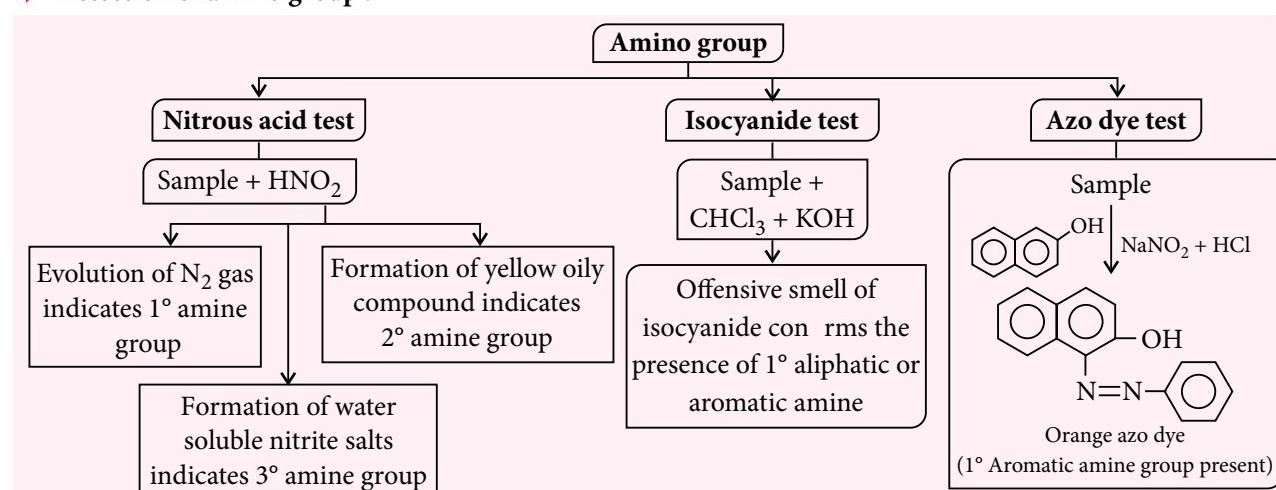
### Detection of phenol :



**Note :** These tests of phenol, can be used to distinguish between alcohols and phenols, as these tests cannot be given by alcohols.



#### Detection of amino group :



#### Detection of carboxylic acid group :

Test	Experiment	Inference
<b>Litmus test</b>	Few drops of sample on blue litmus	Blue litmus paper turns red.
<b>NaHCO<sub>3</sub> test</b>	Sample + NaHCO <sub>3</sub> solution	Brisk effervescence of CO <sub>2</sub> indicates presence of —COOH group.
<b>Ester test</b>	Sample + Alcohol + conc. H <sub>2</sub> SO <sub>4</sub>	Fruity smell of ester infers the presence of —COOH group.

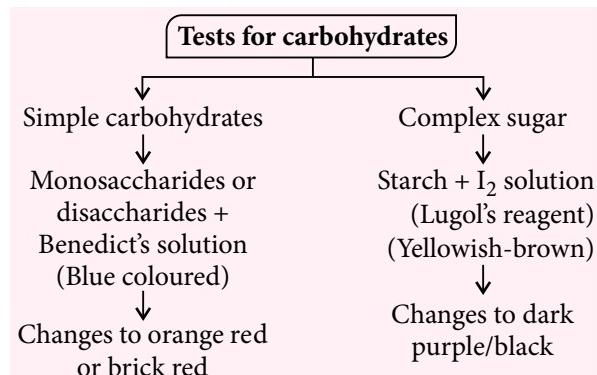
<b>FeCl<sub>3</sub> test</b>	$3RCOOH + FeCl_3 \rightarrow (RCOO)_3Fe$ (Coloured ppt.) + 3HCl	Wine red ppt. : acetic acid Red colour changes to brown ppt. : formic acid No colour change or light yellow colour : oxalic acid Violet coloured ppt. : salicylic acid Buff coloured ppt. : benzoic acid
------------------------------	---	--

#### Detection of nitro group :

<b>Mulliken Barker test</b>	$RNO_2 + 4[H] \xrightarrow{Zn + NH_4Cl} RNHOH + H_2O$ $RNHOH + 2[Ag(NH_3)_2]OH \rightarrow RNO + 2H_2O + 4NH_3$ + 2Ag↓ Grey black ppt.	Appearance of greyish black ppt. indicates the presence of -NO <sub>2</sub> group.
<b>Ferrous hydroxide test</b>	$RNO_2 + 6Fe(OH)_2 + 4H_2O \rightarrow RNH_2 + 6Fe(OH)_3 \downarrow$ Light green Red brown ppt.	Appearance of brown ppt. indicates the presence of -NO <sub>2</sub> group.

## CHARACTERISTICS TESTS OF CARBOHYDRATES, FATS AND PROTEINS

#### Tests for carbohydrates :



#### Tests for lipids :

- **Grease spot test :** Lipid leaves translucent spot on unglazed brown paper bags.
- **Sudan red test :** Sudan red is a fat soluble dye that stains lipids red.

#### Test for proteins :

##### Biuret test :

Biuret solution → Purple or pink solution (For peptides with chain length of at least 3-amino acids)

## PHYSICAL CHEMISTRY

### TITRIMETRIC EXERCISES

➤ **Strength of a solution :** It is the amount of solute in grams present per litre of the solution.

- Strength (g/L) = Normality × Eq. wt.
- Strength (g/L) = Molarity × Mol. mass

➤ **Normality equation :**  $\frac{N_1 V_1}{(\text{Solution 1})} = \frac{N_2 V_2}{(\text{Solution 2})}$

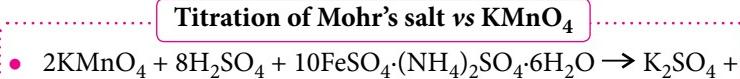
➤ **Molarity equation :**  $\frac{M_1 V_1 n_1}{(\text{Solution 1})} = \frac{M_2 V_2 n_2}{(\text{Solution 2})}$

[∴ N = M × n, where n = valency factor]

➤ **Percentage purity of a given salt**

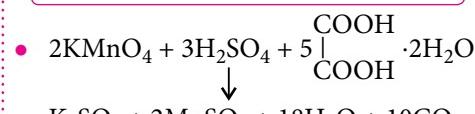
$$= \frac{\text{Strength of pure sample}}{\text{Strength of given sample}} \times 100$$

#### Titration of oxalic acid vs KMnO<sub>4</sub>



• **Calculation :**

$$\frac{M_{KMnO_4} \times V_{KMnO_4}}{M_{\text{Mohr's salt}} \times V_{\text{Mohr's salt}}} = \frac{1}{5}$$



• **Calculation :**

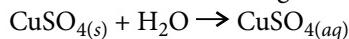
$$\frac{M_{KMnO_4} \times V_{KMnO_4}}{M_{\text{Oxalic acid}} \times V_{\text{Oxalic acid}}} = \frac{2}{5}$$

## Redox titrations

Proceed with transfer of electrons

## THERMOCHEMISTRY

Enthalpy of dissolution of copper sulphate : It is the heat change involved during the dissolution of one mole of a solute in such a large excess of solvent so that no further heat change occurs on dilution.



- Dissolution of  $\text{CuSO}_4$  in water is exothermic. The enthalpy of solution of  $\text{CuSO}_4(s)$  is calculated from the highest temperature attained during its dissolution.
- Calculation :* If dissolution of  $w$  g of  $\text{CuSO}_4$  in 200 g solvent (water) causes  $\Delta t^\circ\text{C}$  change in temperature, then

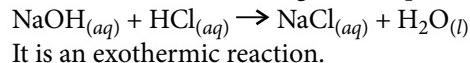
$$\begin{aligned}\text{Heat evolved } (q) &= \text{Mass} \times \text{Specific heat} \times \\ &\quad \text{Change in temperature} \\ q &= (200 + W) \times 4.2 \times \Delta t \text{ J} \\ \text{where, } W &\text{ is water equivalent of calorimeter} \\ &\quad (\text{given}).\end{aligned}$$

Enthalpy of dissolution of  $\text{CuSO}_4$  in water

$$= \frac{q \times 159.5 \times 10^{-3}}{w} \text{ kJ}$$

[ $\because$  Molar mass of  $\text{CuSO}_4 = 159.5$  g]

Enthalpy of neutralisation of strong acid and strong base : It is the enthalpy change accompanying the neutralisation of one gram equivalent of a base by an acid in dilute solution at a given temperature.



It is an exothermic reaction.

- The heat of neutralisation of a strong acid by a strong base in their dilute solutions is generally 57.3 kJ. The reaction may be represented as :  $\text{H}^+_{(aq)} + \text{OH}^-_{(aq)} \rightarrow \text{H}_2\text{O}; \Delta H = -57.3 \text{ kJ}$
- Calculation :* Heat evolved during neutralisation of 100 mL of 0.5 N HCl,

$$q = (200 + W) \times \Delta t \times 4.2 \text{ J} \text{ where, } W \text{ is water equivalent of calorimeter (given).}$$

Thus, enthalpy of neutralisation of 1000 mL of

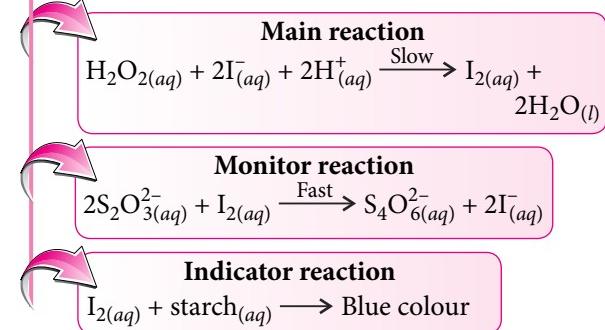
$$1 \text{ N HCl and NaOH} = \frac{q}{0.5 \times 100} \text{ kJ}$$

## MPP CLASS XI ANSWER KEY

- |           |           |             |         |             |
|-----------|-----------|-------------|---------|-------------|
| 1. (b)    | 2. (c)    | 3. (c)      | 4. (d)  | 5. (d)      |
| 6. (c)    | 7. (b)    | 8. (a)      | 9. (b)  | 10. (a)     |
| 11. (a)   | 12. (b)   | 13. (b)     | 14. (b) | 15. (b)     |
| 16. (b)   | 17. (c)   | 18. (b)     | 19. (b) | 20. (a,c,d) |
| 21. (a,c) | 22. (a,b) | 23. (a,b,d) | 24. (4) | 25. (2)     |
| 26. (4)   | 27. (a)   | 28. (a)     | 29. (b) | 30. (d)     |

Kinetic study of reaction of iodide ion with hydrogen peroxide at room temperature :

### Overall reaction(Clock reaction)

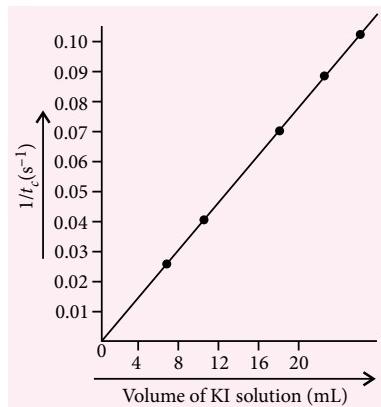


As the concentration of thiosulphate ion is kept constant, the different time taken ( $t_c$ ) for the appearance of blue colour with change in concentration of either reactant indicates the relative rate of reaction.

$$\text{Initial rate} \propto \frac{1}{t_c}$$

The rate of reaction decreases with decrease in the concentration of KI.

The graph of  $1/t_c$  versus volume of KI solution is a straight line.



Rate of reaction  $\propto$  Concentration of KI

Similarly, by keeping  $\text{I}^-$  ion concentration constant and taking different concentrations of  $\text{H}_2\text{O}_2$ , the rate w.r.t.  $\text{H}_2\text{O}_2$  can be found out.

## ELECTROCHEMISTRY

Variation of cell potential in  $\text{Zn}|\text{Zn}^{2+}||\text{Cu}^{2+}|\text{Cu}$  with change in concentration of electrolytes ( $\text{CuSO}_4$  and  $\text{ZnSO}_4$ ) at room temperature :

## Theory

- **Nernst equation :**

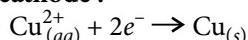
$$E_{\text{cell}} = E_{\text{cell}}^{\circ} - \frac{2.303RT}{nF} \log \frac{[\text{Zn}^{2+}]}{[\text{Cu}^{2+}]} \quad \dots(\text{i})$$

$R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ ,  $T = 298 \text{ K}$  and  $F = 96500 \text{ C}$

**At anode :**



**At cathode :**



Thus,  $n = 2$ ,

$$E_{\text{cell}}^{\circ} = E_{\text{Cu}^{2+}/\text{Cu}}^{\circ} - E_{\text{Zn}^{2+}/\text{Zn}}^{\circ} = +0.34 - (-0.76) \\ = 1.10 \text{ V}$$

Substituting  $E_{\text{cell}}^{\circ}$ ,  $n$ ,  $R$ ,  $T$  and  $F$  in eq. (i)

$$E_{\text{cell}} = 1.10 - \frac{0.059}{2} \log \frac{[\text{Zn}^{2+}]}{[\text{Cu}^{2+}]}$$

### Procedure :

- Clean the electrodes of copper and zinc using a sand paper.
- Put the solution of copper sulphate in beaker and the solution of zinc sulphate in a porous pot.
- Connect the voltmeter with electrodes, close the circuit and note down the cell potentials.
- Repeat the experiment by taking the solutions of  $\text{CuSO}_4$  and  $\text{ZnSO}_4$  at different concentrations.

### Observation :

Concentration of $[\text{Zn}^{2+}]$	Concentration of $[\text{Cu}^{2+}]$	Theoretical $E_{\text{cell}}$
1 M	1 M	1.10 V
0.1 M	1 M	1.1295 V
0.01 M	1 M	1.1591 V

0.001 M	1 M	1.1886 V
1 M	0.1 M	1.0705 V
1 M	0.01 M	1.0409 V
1 M	0.001 M	1.0114 V

### Result :

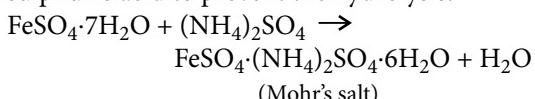
- $E_{\text{cell}}$  decreases with increase in concentration of  $\text{Zn}^{2+}$  in  $\text{ZnSO}_4$ .
- $E_{\text{cell}}$  increases with increase in concentration of  $\text{Cu}^{2+}$  in  $\text{CuSO}_4$ .

## INORGANIC COMPOUNDS

### PREPARATION

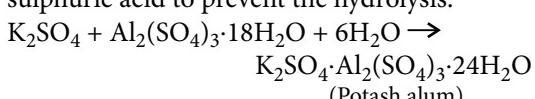
#### Mohr's salt (Ferrous ammonium sulphate) :

- It is a double salt containing ferrous sulphate and ammonium sulphate in equimolar amounts.
- It is prepared by dissolving an equimolar mixture of hydrated ferrous sulphate and ammonium sulphate in water containing a little amount of sulphuric acid to prevent the hydrolysis.



#### Potash alum (Phitkari) :

- It is a double salt containing potassium sulphate and aluminium sulphate in equimolar amounts.
- It is prepared by dissolving an equimolar mixture of hydrated aluminium sulphate and potassium sulphate in water containing a little amount of sulphuric acid to prevent the hydrolysis.



### Fluorescent sensor provides low-cost diagnosis of cystic fibrosis!

Scientists have developed a new diagnostic test for cystic fibrosis. The new device provides a cheaper, easier way to detect levels of chloride in sweat, which are elevated in cystic fibrosis patients. Cystic fibrosis is caused by two faulty copies of a gene that affects the flow of chloride in and out of cells, leading to damage to the lungs and digestive system. Testing chloride levels in sweat is done by manual titration—a labour-intensive technique that is subject to human error and can miss cases. But a new system is based on a fluorescent dye that decreases in the presence of chloride, allowing the test to be automated. To create the sensor, the researchers first developed a citrate-based dye that emits fluorescent light. In the presence of chloride, however, the amount of light given off by the molecule diminishes: the more chloride, the less fluorescence. The new test can detect chloride over a wider range of concentrations and, because it's automated, it avoids the problem of human error. Besides detecting chloride, the new fluorescence-based system can also tell the difference between three ions: chloride, bromide, and iodide.



# SPEED PRACTICE

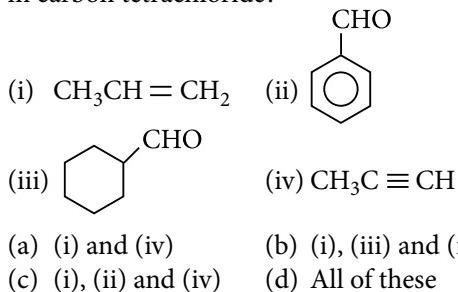
1. The volume of 0.05 M  $\text{KMnO}_4$  solution required to completely oxidise 2.70 g of oxalic acid ( $\text{H}_2\text{C}_2\text{O}_4$ ) in acidic medium is  
 (a)  $120 \text{ cm}^3$       (b)  $240 \text{ cm}^3$   
 (c)  $360 \text{ cm}^3$       (d)  $480 \text{ cm}^3$
2. Which of the following can be used to distinguish between pentan-2-one and pentan-3-one?  
 (a)  $\text{NaHSO}_3$       (b) Brady's reagent  
 (c) Tollens' reagent      (d) Iodoform test
3. The product formed by the reaction of an aldehyde with a primary amine is  
 (a) carboxylic acid      (b) aromatic acid  
 (c) Schiff's base      (d) ketone.  
(NEET Phase-I 2016)
4. In the preparation of *p*-nitroacetanilide from aniline, titration is not done by nitrating mixture because  
 (a) on nitration it gives *o*-nitroacetanilide  
 (b) it gives a mixture of *o*- and *p*-nitroaniline  
 (c)  $-\text{NH}_2$  group gets oxidised  
 (d) it forms a mixture of *o*-and *p*-nitroacetanilide.
5. During experiment to calculate heat of neutralisation of strong acid and strong base, temperature should be recorded till  
 (a) constant temperature is achieved  
 (b) maximum temperature is achieved  
 (c) minimum temperature is achieved  
 (d) none of these.
6. When 3.92 g  $\text{L}^{-1}$  of sample of Mohr's salt reacts completely with 50 mL N/10  $\text{KMnO}_4$  solution. The percentage purity of the sample of Mohr's salt is  
 (a) 50      (b) 70      (c) 37      (d) 40
7. Amount of oxalic acid present in solution can be determined by its titration with  $\text{KMnO}_4$  solution in the presence of  $\text{H}_2\text{SO}_4$ . The titration gives unsatisfactory result when carried out in the presence of HCl, because HCl  
 (a) oxidises oxalic acid to  $\text{CO}_2$  and  $\text{H}_2\text{O}$   
 (b) gets oxidised by oxalic acid to chlorine  
 (c) furnishes  $\text{H}^+$  ions in addition to those from oxalic acid
8. In a protein molecule various amino acids are linked together by  
 (a) peptide bonds      (b) dative bonds  
 (c)  $\alpha$ -glycosidic bonds      (d)  $\beta$ -glycosidic bonds.  
(NEET Phase-I 2016)
9. Two aromatic compounds having formula,  $\text{C}_7\text{H}_8\text{O}$  which are easily identifiable by  $\text{FeCl}_3$  solution test (violet colouration) are  
 (a) *o*-cresol and benzyl alcohol  
 (b) *m*-cresol and *p*-cresol  
 (c) *o*-cresol and *p*-cresol  
 (d) methylphenyl ether and benzyl alcohol.
10. Formic acid can be distinguished from acetic acid by reaction with  
 (a)  $\text{NaHCO}_3$   
 (b) dilute, acidified  $\text{KMnO}_4$  solution  
 (c) 2, 4-dinitrophenylhydrazine  
 (d) Na metal.
11. The carboxyl functional group ( $-\text{COOH}$ ) is present in  
 (a) picric acid      (b) barbituric acid  
 (c) ascorbic acid      (d) aspirin.
12. The volume of 0.1 M oxalic acid that can be completely oxidised by 20 mL of 0.025 M  $\text{KMnO}_4$  solution is  
 (a) 125 mL      (b) 25 mL  
 (c) 12.5 mL      (d) 37.5 mL
13. The most appropriate method of making egg-albumin sol is  
 (a) break an egg carefully and transfer the transparent part of the content to 100 mL of 5% w/V saline solution and stir well  
 (b) keep the egg in boiling water for 10 minutes. After removing the shell, transfer the yellow part of the content to 100 mL of 5% w/V saline solution and homogenise with a mechanical shaker  
 (c) keep the egg in boiling water for 10 minutes. After removing the shell, transfer the white

part of the content to 100 mL of 5% w/V saline solution and homogenise with a mechanical shaker

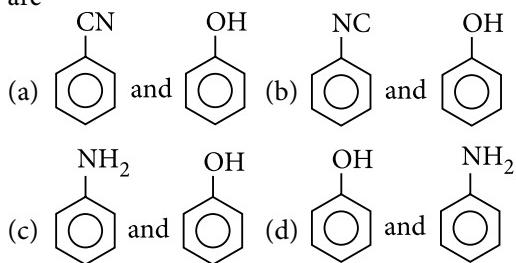
- (d) break an egg carefully and transfer only the yellow part of the content to 100 mL of 5% w/V saline solution and stir well.

(JEE Main 2016 online)

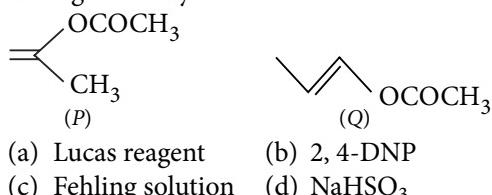
14. Which of the following discharges colour of bromine in carbon tetrachloride?



15. A mixture of two aromatic compounds A and B is separated by dissolving in chloroform followed by extraction with aqueous KOH solution. The alkaline aqueous layer gives a mixture of two isomeric compounds on treatment with carbon tetrachloride. The organic layer containing compound A gives an unpleasant odour on treatment with alcoholic solution of KOH. Compounds A and B respectively are



16. The product of acid hydrolysis of P and Q can be distinguished by



17. A variable, opposite external potential ( $E_{\text{ext}}$ ) is applied to the cell :  $\text{Zn}|\text{Zn}^{2+}(1 \text{ M})||\text{Cu}^{2+}(1 \text{ M})|\text{Cu}$ , of potential 1.1 V. When  $E_{\text{ext}} < 1.1 \text{ V}$  and  $E_{\text{ext}} > 1.1 \text{ V}$  respectively, electrons flow from

- (a) anode to cathode and cathode to anode

- (b) cathode to anode and anode to cathode  
(c) cathode to anode in both the cases  
(d) anode to cathode in both the cases.

(JEE Main 2015 online)

18. A salt made of bivalent ions, each of which is capable of decolorising acidified  $\text{KMnO}_4$  solution. The salt is likely to be

- (a) stannic chloride (b) ferric sulphate  
(c) ferrous sulphate (d) ferrous oxalate.

19. In the cell;



$E_{\text{cell}} - E_{\text{cell}}^{\circ} = 0.0591 \text{ V}$ . The ratio  $C_1/C_2$  at 298 K will be

- (a) 2 (b) 100 (c)  $10^{-2}$  (d) 1

20. Which of the following statements about aniline yellow is not correct?

- (a) It is an azo dye.  
(b) It is a basic dye.  
(c) It can be prepared by heating diazoaminobenzene with aniline and aniline hydrochloride.  
(d) It can be prepared by coupling benzene-diazonium chloride with phenol in the basic medium.

21. The purpose of adding dilute sulphuric acid in the preparation of Mohr's salt is

- (a) to prevent the hydrolysis of ferrous sulphate  
(b) to increase the solubility of the salts used  
(c) to prevent the precipitation of carbonates of metals  
(d) to neutralise ammonium salt.

22. Complete hydrolysis of starch gives

- (a) glucose and fructose in equimolar amount  
(b) galactose and fructose in equimolar amount  
(c) glucose only  
(d) glucose and galactose in equimolar amount.

(JEE Main 2015 online)

23. Dilute sulphuric acid is most suitable for carrying out  $\text{KMnO}_4$  titrations. This is because

- (a) it reacts with  $\text{KMnO}_4$  to liberate nascent oxygen  
(b) it reacts with the reducing agents used in the titration  
(c) the end point in the titration is sharp  
(d) it does not react with  $\text{KMnO}_4$  or the reducing agents used.



CLASS XII

# ACE YOUR WAY

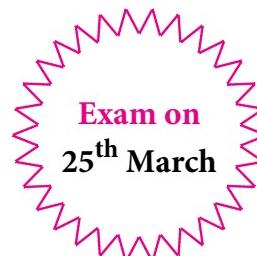
CBSE

Practice Paper 2017

Time Allowed : 3 hours  
Maximum Marks : 70

#### GENERAL INSTRUCTIONS

- (i) All questions are compulsory.
- (ii) Q.no.1 to 5 are very short answer type questions and carry 1 mark each.
- (iii) Q.no.6 to 9 are short answer type questions and carry 2 marks each.
- (iv) Q.no.10 to 13 are short answer type questions and carry 3 marks each.
- (v) Q.no.14 is a hush and question and carries 4 marks.
- (vi) Q.no.15 to 18 are long answer type questions and carry 5 marks each.
- (vii) Usage of tables if necessary, you should consultors is not allowed.



1. What is an adsorption isotherm?
2. Write down the electronic configuration of gadolinium (Gd). (At. number : Gd = 64)
3. Write the structure of the compound : 4-*tert*-butyl-3-iodoheptane
4. What happens when ferrimagnetic  $\text{Fe}_3\text{O}_4$  is heated at 850 K and why?
5. Write the equation involved in the acetylation of salicylic acid.
6.  $[\text{Fe}(\text{CN})_6]^{4-}$  and  $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$  are of different colours in dilute solutions. Why?

#### OR

Discuss the nature of bonding in metal carbonyls.

7. Knowing the electron gain enthalpy values for  $\text{O} \rightarrow \text{O}^-$  and  $\text{O} \rightarrow \text{O}^{2-}$  as -141 and 702 kJ mol<sup>-1</sup> respectively, how can you account for the formation of large number of oxides having  $\text{O}^{2-}$  species and not  $\text{O}^-$ ?
8. Calculate the mass of ascorbic acid (vitamin C,  $\text{C}_6\text{H}_8\text{O}_6$ ) to be dissolved in 75 g acetic acid to lower its freezing point by 1.5°C. ( $K_f = 3.9 \text{ K kg mol}^{-1}$ )
9. A first order reaction has a specific reaction rate of  $10^{-3} \text{ sec}^{-1}$ . How much time will it take for 10 g of the reactant to reduce to 2.5 g? (Given :  $\log 2 = 0.301$ ,  $\log 4 = 0.6021$ ,  $\log 6 = 0.778$ )

10. How will you distinguish between  $(\text{CH}_3)_2\text{NH}$  and  $(\text{CH}_3)_3\text{N}$ ?
11. Answer the following:
  - (i) In a cubic close-packed structure of a mixed oxide one-eighth of tetrahedral voids are occupied by divalent ions,  $X^{2+}$  while one half of the octahedral voids are occupied by trivalent ions,  $Y^{3+}$ . What is the formula of the compound?
  - (ii) Ferric oxide crystallises in a hexagonal close packed array of oxide ions with two out of every three octahedral holes occupied by ferric ions. Derive the formula of the ferric oxide.
12. State the principle involved in refining of metals by each of the following methods :
  - (i) Zone refining
  - (ii) Vapour phase refining
  - (iii) Electrolytic refining
13. Answer the following:
  - (i) In the ring test of  $\text{NO}_3^-$  ion,  $\text{Fe}^{2+}$  ion reduces nitrate ion to nitric oxide, which combines with  $\text{Fe}_{(aq)}^{2+}$  ion to form brown complex. Write the reactions involved in the formation of brown ring.
  - (ii) Write the structure of pyrophosphoric acid and peroxomonophosphoric acid.
14.  $\text{NiCl}_2[\text{P}(\text{C}_2\text{H}_5)_3]_2$  exhibits temperature dependent magnetic behaviour (paramagnetic or diamagnetic). Predict

the coordination geometries of  $\text{Ni}^{2+}$  in which the complex behave as paramagnetic and diamagnetic.

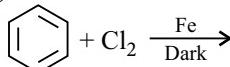
**15.** Answer the following :

(i) Explain why

(a) the dipole moment of chlorobenzene is lower than that of cyclohexyl chloride?

(b) alkyl halides, though polar, are immiscible with water?

(ii) Draw the structure of major monohalo product in the following reaction :



**16.** Explain the following :

(i) How does a delta form at the meeting place of sea and river water?

(ii) What happens when dialysis is prolonged?

(iii) How does the precipitation of colloidal smoke take place in Cottrell precipitator?

**17.** The degree of dissociation of  $\text{Ca}(\text{NO}_3)_2$  in a dilute aqueous solution containing 7.0 g of the salt per 100 g of water at  $100^\circ\text{C}$  is 70 percent. If the vapour pressure of water at  $100^\circ\text{C}$  is 760 mm, calculate the vapour pressure of the solution.

**OR**

At some temperature, the vapour pressure of pure benzene ( $\text{C}_6\text{H}_6$ ) is 0.256 bar and that of pure toluene ( $\text{C}_6\text{H}_5\text{CH}_3$ ) is 0.0925 bar. If the mole fraction of toluene in solution is 0.6. Then,

(i) what will be the total pressure of the solution?

(ii) what will be the mole fraction of each component in vapour phase?

**18.** Answer the following :

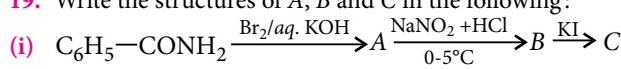
(i) What is a developer used in photography and how does it work?

(ii) How will you synthesise

(a) 1-phenylethanol from a suitable alkene?

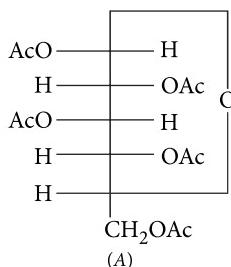
(b) cyclohexylmethanol using an alkyl halide by an  $\text{S}_{\text{N}}2$  reaction?

**19.** Write the structures of A, B and C in the following:



**20.** Account for the following :

(i) Why does compound (A) given below not form an oxime?



(ii) Why must vitamin C be supplied regularly in diet?

(iii) Activation energy for the acid catalysed hydrolysis of

sucrose is 6.22 kJ mol<sup>-1</sup>, while the activation energy is only 2.15 kJ mol<sup>-1</sup> when hydrolysis is catalysed by the enzyme sucrase. Explain.

**21.** Answer the following :

(i) The half-life for radioactive decay of  ${}^{14}\text{C}$  is 5730 years. An archaeological artifact containing wood had only 80% of the  ${}^{14}\text{C}$  found in a living tree. Calculate the age of the sample.

(ii) Why does the rate of a reaction not remain constant throughout the reaction process?

**22.** Answer the following :

(i) Why does *cis*-polyisoprene possess elastic properties?

(ii) Which factor imparts crystalline nature to a polymer like nylon?

(iii) Why should the monomers used in addition polymerisation through free radical pathway be very pure?

**23.** Sonam is a student of Class XII. Once her mother fell down from stairs and her leg bruised with lot of pain. Sonam gave her mother a non-narcotic analgesic which was safe to use. Her mother questioned if there is some other type of analgesic as well. Sonam replied affirmatively and told her mother that narcotic analgesics should be taken only when one is in acute pain.

After reading the above passage, answer the following questions :

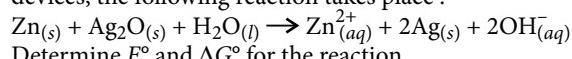
(i) What values are expressed by Sonam by her choice about using narcotic and non-narcotic analgesics?

(ii) Give some examples of narcotic and non-narcotic analgesics.

(iii) Give one example of an antipyretic which also acts as an analgesic. How does it work as an analgesic?

**24.** Answer the following :

(i) In the button cells, widely used in watches and other devices, the following reaction takes place :



(Given :  $E^\circ_{\text{Ag}^+/Ag} = +0.80 \text{ V}$ ,  $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76 \text{ V}$ )

(ii) What type of a battery is the lead storage battery? Write the anode and the cathode reactions and the overall reaction occurring in a lead storage battery when current is drawn from it.

**OR**

Answer the following :

(i) The cell in which the following reaction occurs,  
 $2\text{Fe}^{3+}_{(aq)} + 2\text{I}^-_{(aq)} \rightarrow 2\text{Fe}^{2+}_{(aq)} + \text{I}_2_{(s)}$  has  $E^\circ_{\text{cell}} = 0.236 \text{ V}$  at 298 K, calculate the standard Gibbs energy and the equilibrium constant of the cell reaction.

(ii) The chemistry of corrosion of iron is essentially an electrochemical phenomenon. Explain the reactions occurring during the corrosion of iron in the atmosphere.

**25.** Answer the following :

(i) A blackish brown coloured solid 'A' when fused with alkali metal hydroxide in presence of air, produces a dark green coloured compound 'B', which on electrolytic oxidation

in alkaline medium gives a dark purple coloured compound 'C'. Identify A, B and C and write the reactions involved.

(ii) What happens when an acidic solution of the green compound (B) is allowed to stand for some time? Give the equation involved. What is this type of reaction called?

**OR**

Answer the following :

(i) Explain why mercury(I) ion exists as  $Hg_2^{2+}$  ion, while copper(I) exists as  $Cu^+$  ion.

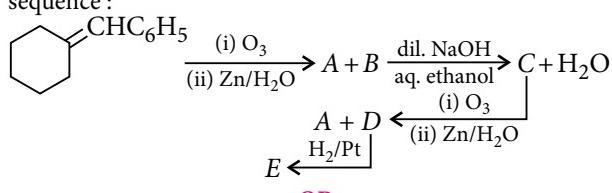
(ii) Assign suitable reasons for the following :

(a)  $Mn^{2+}$  compounds are more stable than  $Fe^{2+}$  compounds towards oxidation to their +3 oxidation state.

(b) In the 3d series from Sc ( $Z = 21$ ) to Zn ( $Z = 30$ ), the enthalpy of atomisation of Zn is the lowest.

(c)  $Sc^{3+}$  is colourless in aqueous solution whereas  $Ti^{3+}$  is coloured.

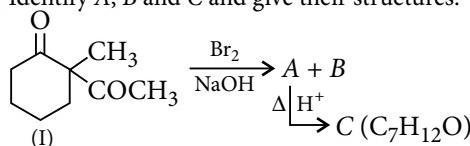
26. Identify compounds (A to D) in the following reactions sequence :



Answer the following :

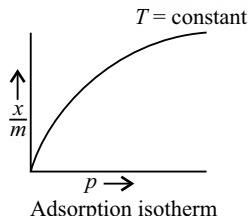
(i) A compound with molecular formula,  $C_4H_{10}O_3$  on acetylation with acetic anhydride gives a compound with molecular weight 190. Find out the number of hydroxyl groups present in the compound.

(ii) Identify A, B and C and give their structures.



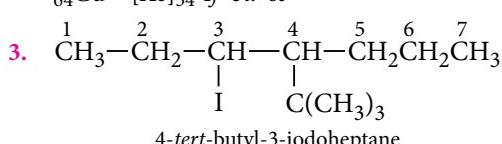
### SOLUTIONS

1. Adsorption isotherm is the variation of the amount of gas adsorbed by the adsorbent with pressure at constant temperature.

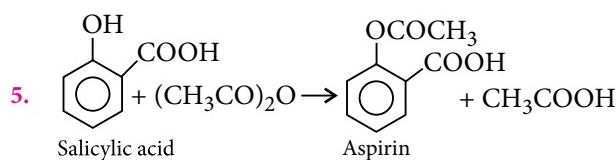


2. The electronic configuration of gadolinium is

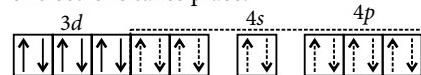
$$^{64}\text{Gd} = [\text{Xe}]_{54} 4f^7 5d^1 6s^2$$



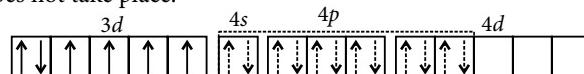
4. When ferrimagnetic  $\text{Fe}_3\text{O}_4$  is heated at 850 K, it loses ferrimagnetism and becomes paramagnetic due to alignment of spins in one direction.



6. In  $[\text{Fe}(\text{CN})_6]^{4-}$ ,  $\text{CN}^-$  is a strong field ligand hence, pairing of electrons takes place.

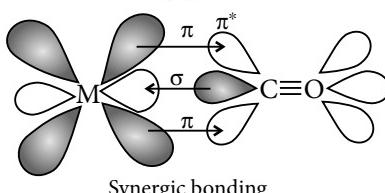


In  $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ ,  $\text{H}_2\text{O}$  is a weak field ligand hence, pairing does not take place.



Both ligands show different magnitude of crystal field splitting energy due to different nature hence, absorb different wavelengths and show different colours.

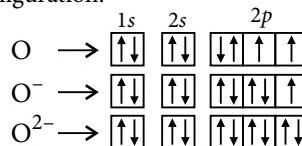
**OR**



Synergic bonding

The metal-carbon bond in metal carbonyls possess both  $\sigma$  and  $\pi$  character. The  $M-C$   $\sigma$  bond is formed by the donation of lone pair of electrons on the carbonyl carbon into a vacant orbital of the metal. The  $M-C$   $\pi$  bond is formed by the donation of a pair of electrons from a filled  $d$ -orbital of metal into the vacant antibonding  $\pi^*$  orbital of carbon monoxide. The metal to ligand bonding creates a synergic effect which strengthens the bond between CO and the metal.

7. This can be explained with the help of electronic configuration.



As  $O^{2-}$  has most stable configuration amongst these. So, formation of  $O^{2-}$  is much more easier. In solid state, large amount of energy (lattice enthalpy) is released when oxides are formed with divalent  $O^{2-}$  ions. It is greater lattice enthalpy of the crystal lattice of oxide ( $O^{2-}$ ) which compensates for the high energy required to add the second electron.

8. Lowering in freezing point ( $\Delta T_f$ ) =  $1.5^\circ\text{C}$

Mass of solvent ( $\text{CH}_3\text{COOH}$ ),  $w_1 = 75\text{ g}$

Mass of solute,  $w_2 = ?$

Molar mass of solute,  $C_6H_8O_6$ ,  $M_2 = 72 + 8 + 96 = 176\text{ g mol}^{-1}$

$$\Delta T_f = K_f \times \frac{w_2 \times 1000}{M_2 \times w_1}$$

$$\text{or } w_2 = \frac{M_2 \times w_1 \times \Delta T_f}{1000 \times K_f} = \frac{176 \times 75 \times 1.5}{1000 \times 3.9} = 5.08\text{ g}$$

9. We know that for a first order reaction,

$$t = \frac{2.303}{k} \log \frac{a}{a-x}$$

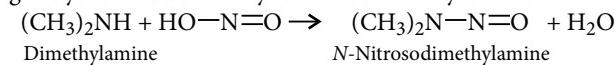
Here, initial concentration,  $a = 10$  g and concentration left after time  $t$  sec. = 2.5 g, i.e.,  $(a - x) = 2.5$  g

Specific reaction constant,  $k = 10^{-3}$  sec $^{-1}$

$\therefore$  Time required for the reactant to reduce to 2.5 g

$$= \frac{2.303}{10^{-3} \text{ s}^{-1}} \times \log \frac{10}{2.5} = \frac{2.303}{10^{-3}} \times \log 4 = \frac{2.303}{10^{-3}} \times 0.6021 \\ = 1386.6 \text{ sec}$$

10. These can be distinguished by Liebermann's nitrosoamine reaction.  $(\text{CH}_3)_2\text{NH}$  (dimethylamine) on treatment with  $\text{HNO}_2$  (generated in situ by the action of dil. HCl on  $\text{NaNO}_2$ ) gives yellow coloured oily *N*-nitrosodimethylamine.



*N*-Nitrosodimethylamine on warming with a crystal of phenol and conc.  $\text{H}_2\text{SO}_4$  forms a green solution which when made alkaline with aqueous  $\text{NaOH}$  turns deep blue and then red on dilution.

$(\text{CH}_3)_3\text{N}$  (trimethylamine), on the other hand, being a 3° amine does not give this test.

11. (i) Let the number of  $\text{O}^{2-}$  ions in the crystal be  $N$ .

$\therefore$  Number of tetrahedral voids =  $2N$

Number of octahedral voids =  $N$

$$\therefore \text{Number of } X^{2+} \text{ ions} = \frac{1}{8} \times 2N = \frac{N}{4}$$

$$\text{Number of } Y^{3+} \text{ ions} = \frac{1}{2} \times N = \frac{N}{2}$$

$$X^{2+} : Y^{3+} : \text{O}^{2-} = \frac{1}{4} : \frac{1}{2} : 1 = 1 : 2 : 4$$

$\therefore$  The formula of the compound is  $XY_2\text{O}_4$ .

(ii) There is one octahedral hole for each atom in hexagonal closed packed arrangement. If the number of oxide ions ( $\text{O}^{2-}$ ) per unit cell is  $x$ , then

$$\text{Number of } \text{Fe}^{3+} \text{ ions} = 2/3 \times \text{octahedral holes} = \frac{2}{3} \times x = \frac{2x}{3}$$

$$\therefore \text{Ratio of } \text{Fe}^{3+} : \text{O}^{2-} = \frac{2x}{3} : x = 2 : 3$$

Thus, formula of compound is  $\text{Fe}_2\text{O}_3$ .

12. (i) Zone refining is based on the principle that the impurities are more soluble in the melt than in the solid state of the metal.

(ii) In vapour phase refining, the metal is converted into a suitable volatile compound and then decomposed to give pure metal. So, the two requirements are :

(a) The metal should form a volatile compound with a suitable reagent.

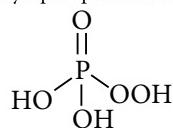
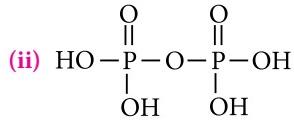
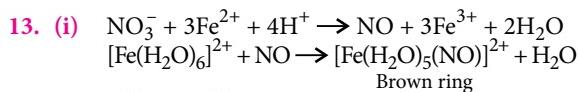
(b) The volatile compound should be easily decomposable, so that the recovery is easy.

(iii) Zinc is refined by electrolytic refining. In this method, the impure metal is made to act as anode. A strip of the same metal in pure form is used as cathode. They are put in a

suitable electrolytic bath containing soluble salt of the same metal. The more basic metal remains in the solution and the less basic ones go to the anode mud.

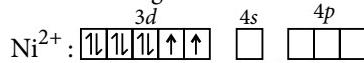
At anode :  $\text{Zn} \rightarrow \text{Zn}^{2+} + 2e^-$

At cathode :  $\text{Zn}^{2+} + 2e^- \rightarrow \text{Zn}$

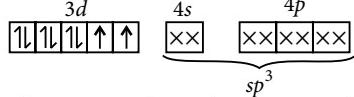


Peroxomonophosphoric acid

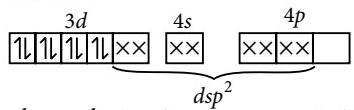
14. In the given complex,  $\text{NiCl}_2[\text{P}(\text{C}_2\text{H}_5)_3]_2$ , nickel is in +2 oxidation state and the ground state electronic configuration of  $\text{Ni}^{2+}$  ion in free gaseous state is



For the given four coordinated complex to be paramagnetic, it must possess unpaired electrons in the valence shell. To satisfy this condition, lone pairs from the four ligands occupy the four  $sp^3$  hybrid orbitals as :



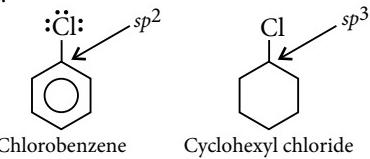
Therefore, geometry of paramagnetic complex must be tetrahedral. On the other hand, for complex to be diamagnetic, there should not be any unpaired electrons in the valence shell. This condition can be fulfilled by pairing electrons of  $3d$ -orbitals as



The above electronic arrangement gives  $dsp^2$  hybridisation and therefore, square planar geometry.

15. (i) (a) There are two reasons :

1. In case of chlorobenzene, carbon to which chlorine is attached is  $sp^2$  hybridised and is more electronegative than the corresponding carbon in cyclohexyl chloride which is  $sp^3$  hybridised. So, the net dipole moment is lower in chlorobenzene.



2. In chlorobenzene C—Cl bond has some double bond character so, its bond length is smaller. Hence, dipole moment is smaller than cyclohexyl chloride which has a longer C—Cl single bond.



**20. (i)** Glucose pentaacetate (*A*) does not have a free –OH at C-1 and so cannot be converted to the open chain form to give –CHO group hence, it does not form the oxime.

**(ii)** Vitamin C is water soluble hence it is readily excreted in urine and cannot be stored in the body.

**(iii)** Enzymes are biocatalysts which reduce the magnitude of activation energy by providing alternative path. In the hydrolysis of sucrose, the enzyme sucrase reduces the activation energy from  $6.22 \text{ kJ mol}^{-1}$  to  $2.15 \text{ kJ mol}^{-1}$ .

$$21. \text{ (i)} \quad t_{1/2} = \frac{0.693}{k} \quad (\text{For first order reaction})$$

$$\therefore k = \frac{0.693}{t_{1/2}} = \frac{0.693}{5730} \text{ yr}^{-1}$$

We know that,

$$\begin{aligned} t &= \frac{2.303}{k} \log \frac{[R]_0}{[R]} = \frac{2.303}{0.693} \log \frac{100}{80} \\ &= \frac{2.303 \times 5730}{0.693} \log \frac{100}{80} = \frac{2.303 \times 5730}{0.693} \log 1.25 \\ &= \frac{2.303 \times 5730}{0.693} \times 0.0969 = 1845 \text{ yr (approx.)} \end{aligned}$$

Therefore, the age of the given archaeological artifact containing wood is 1845 years.

**(ii)** The rate of a reaction does not remain constant throughout the reaction process because the rate of the reaction depends upon concentration of reactants which keeps on decreasing.

**22. (i)** The *cis*-polyisoprene molecule consists of various chains held together by weak van der Waals interactions and has a coiled structure. Hence, it can be stretched like a spring and exhibits elastic properties.

**(ii)** Strong intermolecular forces like hydrogen bonding lead to close packing of polymer chains and thus, impart crystalline nature to nylon.

**(iii)** Even the traces of impurities may act like inhibitors which stop the growth of the polymers and polymers with shorter chain length are formed. Hence, pure monomers are required for polymerisation through free radical pathway.

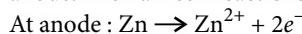
**23. (i)** Sonam expressed values about the safety in choosing analgesics and her awareness about drugs. Non-narcotic analgesics are non-addictive and hence, are safe to use but narcotic analgesics are addictive, *i.e.*, habit forming and hence, are not safe to use. Therefore, narcotic analgesics should be used only in severe pain such as post-operative pain, cardiac pain, pains of terminal cancer and in child birth.

**(ii)** Examples of non-narcotic analgesics are : aspirin, paracetamol, naproxen, ibuprofen and diclofenac sodium. Examples of narcotic analgesics are : morphine, codeine and heroin.

**(iii)** Aspirin acts both as an antipyretic as well as an analgesic. Its analgesic action is due to the reason that it inhibits the

synthesis of prostaglandins which stimulate inflammation in the tissues and cause pain.

**24. (i)** Since,  $E_{\text{Ag}^+/\text{Ag}}^\circ > E_{\text{Zn}^{2+}/\text{Zn}}^\circ$ , the zinc electrode is the anode. The half-cell reactions are as follows:



Overall cell reaction is



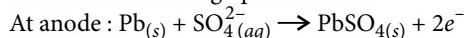
$$\begin{aligned} E_{\text{cell}}^\circ &= E_{\text{cathode}}^\circ - E_{\text{anode}}^\circ = 0.80 \text{ V} - (-0.76) \text{ V} \\ &= 0.80 \text{ V} + (0.76) \text{ V} = 1.56 \text{ V} \end{aligned}$$

Number of electrons involved is 2. Therefore,  $\Delta G^\circ$  value is given by the formula,

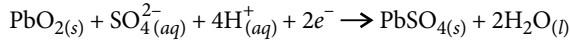
$$\begin{aligned} \Delta G^\circ &= -nFE_{\text{cell}}^\circ = -2 \times 96500 \text{ C mol}^{-1} \times 1.56 \text{ V} \\ &= -301080 \text{ J mol}^{-1} = -301.08 \text{ kJ mol}^{-1} \end{aligned}$$

**(ii)** Lead storage battery is a secondary cell.

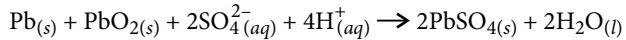
Cell reactions during operation are :



At cathode :

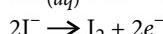
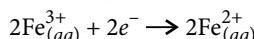


Overall reaction :



**OR**

**(i)** Two half reactions for the given redox reaction may be written as :



2 moles of electrons are involved in the reaction, so  $n = 2$

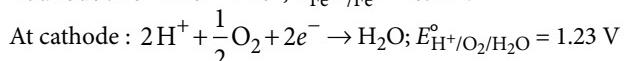
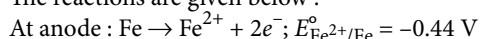
$$\begin{aligned} \Delta_r G^\circ &= -nFE_{\text{cell}}^\circ = -(2 \text{ mol}) \times (96500 \text{ C mol}^{-1}) \times (0.236 \text{ V}) \\ &= -45548 \text{ J} = -45.55 \text{ kJ} \end{aligned}$$

$$\log K_c = -\frac{\Delta G^\circ}{2.303 RT}$$

$$= -\frac{(-45.55 \text{ kJ})}{2.303 \times (8.314 \times 10^{-3} \text{ kJ K}^{-1}) \times (298 \text{ K})} = 7.983$$

$$K_c = \text{antilog } (7.983) = 9.616 \times 10^7$$

**(ii)** According to electrochemical theory of rusting, the impure iron surface behaves like small electrochemical cell. Moisture having dissolved  $\text{CO}_2$  or  $\text{O}_2$  acts as an electrolyte. The reactions are given below :

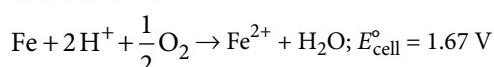


## MPP CLASS XII

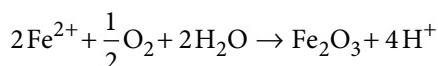
## ANSWER KEY

- |             |           |             |         |           |
|-------------|-----------|-------------|---------|-----------|
| 1. (b)      | 2. (b)    | 3. (c)      | 4. (b)  | 5. (b)    |
| 6. (d)      | 7. (a)    | 8. (a)      | 9. (a)  | 10. (c)   |
| 11. (c)     | 12. (b)   | 13. (a)     | 14. (a) | 15. (b)   |
| 16. (d)     | 17. (c)   | 18. (a)     | 19. (d) | 20. (b,d) |
| 21. (a,b,c) | 22. (b,c) | 23. (a,b,c) | 24. (8) | 25. (9)   |
| 26. (6)     | 27. (b)   | 28. (a)     | 29. (c) | 30. (b)   |

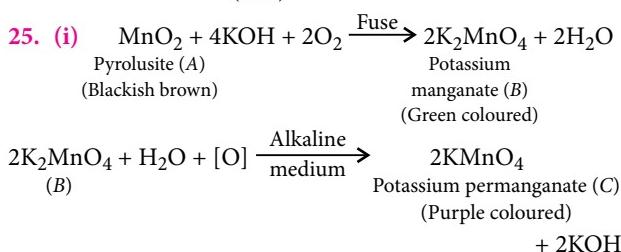
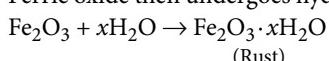
Overall reaction :



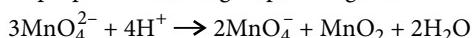
The ferrous ions formed react with the dissolved oxygen or oxygen from the air to form ferric oxide with further production of  $\text{H}^+$  ions.



Ferric oxide then undergoes hydration to form rust as follow:



**(ii)** When acidic solution of green compound (B), i.e., potassium manganate is allowed to stand for some time, it disproportionates to give permanganate as follows :



These type of reactions are called disproportionation reactions.

**OR**

**(i)** The electronic configuration of  $\text{Hg(I)}$  is  $[\text{Xe}]4f^{14} 5d^{10} 6s^1$ . It has one unpaired electron in the valence  $6s$ -subshell. It is paramagnetic but actually  $\text{Hg(I)}$  compounds are diamagnetic. This change can be explained by assuming that the singly filled  $6s$ -orbitals of two  $\text{Hg}^+$  ions overlap to form  $\text{Hg}-\text{Hg}$  covalent bond.

Therefore,  $\text{Hg}^+$  ion exists as dimeric species, i.e.,  $\text{Hg}_2^{2+}$ . On the other hand,  $\text{Cu(I)}$  ion has electronic configuration  $[\text{Ar}]3d^1$ . It has no unpaired electron to form dimeric  $\text{Cu}_2^{2+}$  species and therefore, it exists as  $\text{Cu}^+$  ion.

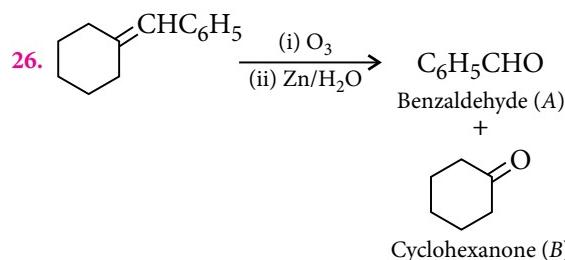
**(ii) (a)** Electronic configuration of  $\text{Mn}^{2+}$  is  $3d^5$  which is half filled and hence, stable. Therefore, third ionisation enthalpy is very high, i.e.,  $3^{\text{rd}}$  electron cannot be lost easily. In case of  $\text{Fe}^{2+}$ , electronic configuration is  $3d^6$ . Hence, it can lose one electron easily to give the stable configuration,  $3d^5$ .

**(b)** Zinc ( $Z = 30$ ) has completely filled  $d$ -orbitals ( $3d^{10}$ ). The extent of metallic bonding is more, more will be enthalpy of atomisation. Due to absence of unpaired electrons, the interatomic electronic bonding is the weakest in Zn and thus, has least enthalpy of atomisation.

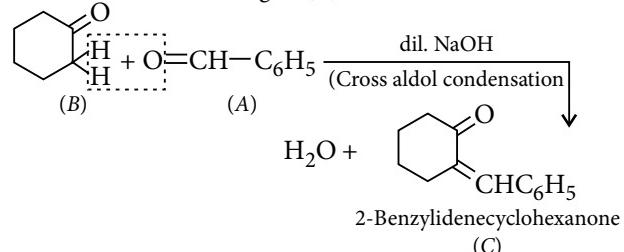
**(c)** Only those ions are coloured which have partially filled  $d$ -orbitals facilitating  $d-d$  transitions.

Electronic configuration of  $\text{Sc}^{3+} = [\text{Ar}]$

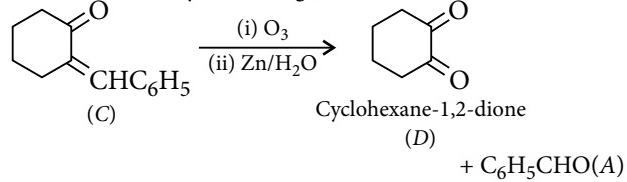
Electronic configuration of  $\text{Ti}^{3+} = [\text{Ar}]3d^1$



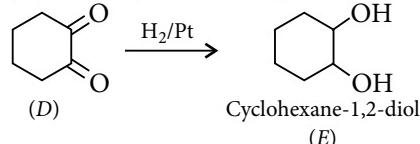
Now compound (B) has  $\alpha$ -hydrogens but (A) does not, therefore, in presence of dil.  $\text{NaOH}$ , cross aldol condensation occurs between them to give (C).



Reductive ozonolysis of (C) gives (D) and (A).



(D) on catalytic reduction gives cyclohexane-1, 2-diol (E).



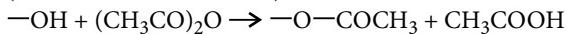
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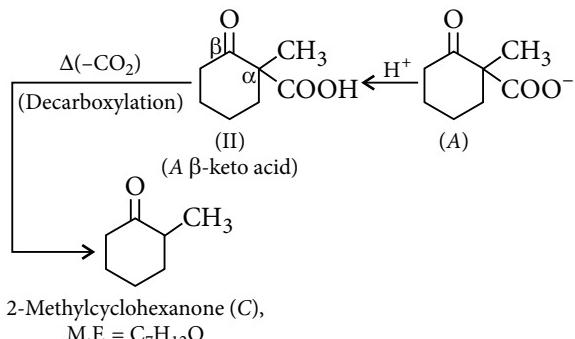
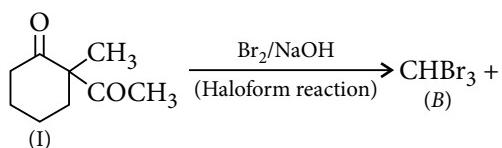
(i) During acetylation, one H-atom (at. mass = 1 amu) of the OH group is replaced by an acetyl group, i.e.,  $\text{CH}_3\text{CO}$  (molecular mass = 43 amu).



In other words, acetylation of each OH group increases mass by  $(43 - 1 =)$  42 amu. Now, the molecular mass of  $\text{C}_4\text{H}_{10}\text{O}_3$  = 106 amu while that of the acetylated product is 190 amu, therefore, the number of OH groups in the compound

$$= \frac{190 - 106}{42} = 2$$

(ii) The given compound (I) contains  $\text{CH}_3\text{CO}-$  group and hence, in presence of  $\text{Br}_2/\text{NaOH}$ , it undergoes haloform reaction to give sodium salt of carboxylic acid (A) and bromoform,  $\text{CHBr}_3$  (B). (A) on protonation gives the corresponding acid (II). (II) being a  $\beta$ -keto acid readily undergoes decarboxylation on heating to give 2-methylcyclohexanone (C).



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Class XII

This specially designed column enables students to self analyse their extent of understanding of complete syllabus. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.



Total Marks : 120

Time Taken : 60 Min.

## NEET / AIIMS

### Only One Option Correct Type

- The fraction of the total volume occupied by the atoms present in a simple cube is  
 (a)  $\frac{\pi}{4}$     (b)  $\frac{\pi}{6}$     (c)  $\frac{\pi}{3\sqrt{2}}$     (d)  $\frac{\pi}{4\sqrt{2}}$
- 1.0 molar solution of the complex salt,  $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$ , displays an osmotic pressure of  $3RT$ . 0.5 L of the same solution on treatment with excess of  $\text{AgNO}_3$  solution will yield (assume  $\alpha = 1$ )  
 (a) 0.5 mol of  $\text{AgCl}$     (b) 1.0 mol of  $\text{AgCl}$   
 (c) 1.5 mol of  $\text{AgCl}$     (d) 3.0 mol of  $\text{AgCl}$ .
- A galvanic cell is set up from a zinc bar weighing 100 g and 1.0 litre of 1.0 M  $\text{CuSO}_4$  solution. How long would the cell run if it is assumed to deliver a steady current of 1.0 ampere?  
 (Atomic mass of Zn = 65)  
 (a) 1.1 hr    (b) 46 hr    (c) 53.6 hr    (d) 24 hr
- The rate constant of a zero order reaction is  $0.2 \text{ mol dm}^{-3} \text{ hr}^{-1}$ . If the concentration of the reactant after 30 minutes is  $0.05 \text{ mol dm}^{-3}$ , then its initial concentration would be  
 (a)  $0.01 \text{ mol dm}^{-3}$     (a)  $0.15 \text{ mol dm}^{-3}$   
 (c)  $0.25 \text{ mol dm}^{-3}$     (d)  $4.00 \text{ mol dm}^{-3}$
- Which of the following will show Tyndall effect?  
 (a) Aqueous solution of soap below critical micelle concentration.  
 (b) Aqueous solution of soap above critical micelle concentration.  
 (c) Aqueous solution of sodium chloride.  
 (d) Aqueous solution of sugar.

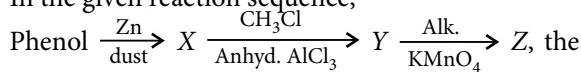
- Which of the following reactions is an example of calcination process?  
 (a)  $2\text{Ag} + 2\text{HCl} + [\text{O}] \longrightarrow 2\text{AgCl} + \text{H}_2\text{O}$   
 (b)  $2\text{Zn} + \text{O}_2 \longrightarrow 2\text{ZnO}$   
 (c)  $2\text{ZnS} + 3\text{O}_2 \longrightarrow 2\text{ZnO} + 2\text{SO}_2$   
 (d)  $\text{MgCO}_3 \longrightarrow \text{MgO} + \text{CO}_2$
- The following acids have been arranged in the order of decreasing acid strength. Identify the correct order.  
 I.  $\text{ClOH}$                           II.  $\text{BrOH}$   
 III.  $\text{IOH}$                                   (a) I > II > III                          (b) II > I > III  
 (c) III > II > I                                  (d) I > III > II
- What would happen when a solution of potassium chromate is treated with an excess of dilute nitric acid?  
 (a)  $\text{Cr}_2\text{O}_7^{2-}$  and  $\text{H}_2\text{O}$  are formed.  
 (b)  $\text{CrO}_4^{2-}$  is reduced to  $\text{Cr}^{3+}$ .  
 (c)  $\text{CrO}_4^{2-}$  is oxidised to  $\text{Cr}^{7+}$ .  
 (d)  $\text{Cr}^{3+}$  and  $\text{Cr}_2\text{O}_7^{2-}$  are formed.
- Among the following, the species having square planar geometry for central atom are  
 (i)  $\text{XeF}_4$                                   (ii)  $\text{SF}_4$   
 (iii)  $[\text{NiCl}_4]^{2-}$                                   (iv)  $[\text{PdCl}_4]^{2-}$   
 (a) (i) and (iv)                                  (b) (i) and (ii)  
 (c) (ii) and (iii)    (d) (iii) and (iv)
- $B \xleftarrow[\text{(major)}]{\text{CH}_3\text{CH}_2\text{OH}} \text{CH}_3-\underset{\text{CH}_3}{\underset{|}{\text{C}}} \text{Br} \xrightarrow[\text{(major)}]{\text{CH}_3\text{CH}_2\text{OH}} A$

Identify A and B.

- (a) Both A and B are  $(\text{CH}_3)_3\text{COCH}_2\text{CH}_3$ .
- (b) Both A and B are  $(\text{CH}_3)_2\text{C}=\text{CH}_2$ .
- (c) A is  $(\text{CH}_3)_3\text{COCH}_2\text{CH}_3$  and B is  $(\text{CH}_3)_2\text{C}=\text{CH}_2$ .
- (d) A is  $(\text{CH}_3)_2\text{C}=\text{CH}_2$  and B is  $(\text{CH}_3)_3\text{COCH}_2\text{CH}_3$ .

11. An organic compound with molecular formula,  $\text{C}_2\text{H}_6\text{O}_2$  evolves  $\text{H}_2$  when treated with sodium metal and gives two moles of formaldehyde on oxidation with  $\text{HIO}_4$ . The compound is
  - (a) acetic acid
  - (b) methyl acetate
  - (c) ethylene glycol
  - (d) ethyl alcohol.

12. In the given reaction sequence,



- product Z is
  - (a) benzaldehyde
  - (b) benzoic acid
  - (c) benzene
  - (d) toluene.

#### Assertion & Reason Type

**Directions :** In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :

- (a) If both assertion and reason are true and reason is the correct explanation of assertion.
- (b) If both assertion and reason are true but reason is not the correct explanation of assertion.
- (c) If assertion is true but reason is false.
- (d) If both assertion and reason are false.

13. **Assertion :** Acylation of amines gives a monosubstituted product whereas alkylation of amines gives polysubstituted product.

**Reason :** Acyl group sterically hinders the approach of further acyl group.

14. **Assertion :**  $\alpha$ -amino acids exist as internal salt in solution as they have amino and carboxylic acid groups in near vicinity.

**Reason :**  $\text{H}^+$  ion given by carboxyl group ( $-\text{COOH}$ ) is captured by amino group ( $-\text{NH}_2$ ) having lone pair of electrons.

15. **Assertion :** Detergents are preferred to soaps for washing purposes.

**Reason :** Detergents having branched hydrocarbon chains are non-biodegradable.

#### JEE MAIN / JEE ADVANCED / PETs

#### Only One Option Correct Type

16. Element 'X' crystallises in a 12 coordination fcc lattice. On applying high temperature, it changes to 8 coordination bcc lattice. The ratio of the density

of the crystal lattice before and after applying high temperature will be

- (a) 1 : 1
- (b) 3 : 2
- (c)  $\sqrt{2} : \sqrt{3}$
- (d)  $2(\sqrt{2})^3 : (\sqrt{3})^3$

17. The ionic strength of a solution containing 0.1 mole/kg of  $\text{KCl}$  and 0.2 mole/kg of  $\text{CuSO}_4$  is

- (a) 0.3
- (b) 0.6
- (c) 0.9
- (d) 0.2

18. Compound 'A' (molecular formula  $\text{C}_3\text{H}_8\text{O}$ ) is treated with acidified potassium dichromate to form a product 'B' (molecular formula  $\text{C}_3\text{H}_6\text{O}$ ). 'B' forms a shining silver mirror on warming with ammoniacal silver nitrate. 'B' when treated with an aqueous solution of  $\text{H}_2\text{NCONHNH}_2\text{-HCl}$  and sodium acetate gives a product 'C'. Identify the structure of 'C'.

- (a)  $\text{CH}_3\text{CH}_2\text{CH}=\text{NNHCONH}_2$
- (b)  $\text{CH}_3-\overset{\text{CH}_3}{\underset{|}{\text{C}}}=\text{NNHCONH}_2$
- (c)  $\text{CH}_3-\overset{\text{CH}_3}{\underset{|}{\text{C}}}=\text{NCONHNH}_2$
- (d)  $\text{CH}_3\text{CH}_2\text{CH}=\text{NCONHNH}_2$

19. A dark brown solid (X) reacts with  $\text{NH}_3$  to form a mild explosive which decomposes to give a violet coloured gas. (X) also reacts with  $\text{H}_2$  to give an acid (Y). (Y) can also be prepared by heating its salt with  $\text{H}_3\text{PO}_4$ . X and Y are respectively

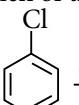
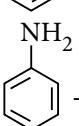
- (a)  $\text{Cl}_2, \text{HCl}$
- (b)  $\text{SO}_2, \text{H}_2\text{SO}_4$
- (c)  $\text{Br}_2, \text{HBr}$
- (d)  $\text{I}_2, \text{HI}$

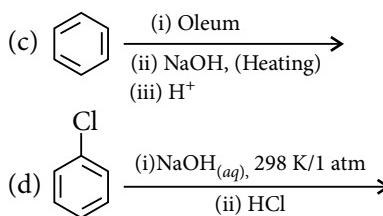
#### More than One Options Correct Type

20. Aryl halides are less reactive towards nucleophilic substitution reactions as compared to alkyl halides due to

- (a) longer carbon-halogen bond
- (b) resonance stabilisation
- (c) the inductive effect
- (d)  $sp^2$ -hybridised carbon attached to halogen.

21. Which of the following reactions will yield phenol?

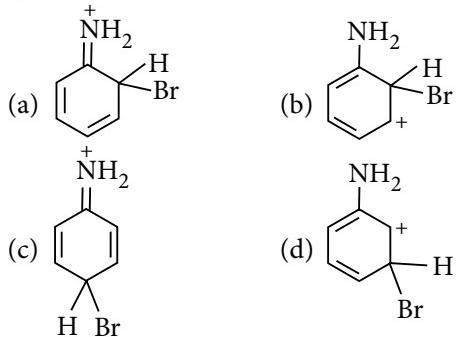
- (a)   $\xrightarrow[\text{(ii) H}_2\text{O}/\text{H}^+]{\text{(i) fusion with NaOH at } 300 \text{ atm}}$
- (b)   $\xrightarrow[\text{(ii) H}_2\text{O (Warming)}]{\text{(i) NaNO}_2/\text{HCl}}$



22. An aqueous pink solution of cobalt(II) chloride changes to deep blue on addition of excess of HCl. This is because

  - (a)  $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$  is transformed into  $[\text{CoCl}_6]^{4-}$
  - (b)  $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$  is transformed into  $[\text{CoCl}_4]^{2-}$
  - (c) tetrahedral complexes have smaller crystal field splitting than octahedral complexes
  - (d) tetrahedral complexes have larger crystal field splitting than octahedral complexes.

- 23.** Arenium ion involved in the bromination of aniline is



## Integer Answer Type

- 24.** The total number of  $\alpha$  and  $\beta$  particles emitted in the nuclear reaction,  $^{238}_{92}\text{U} \rightarrow ^{214}_{82}\text{Pb}$  is

**25.** An organic compound undergoes first order decomposition. The time taken for its decomposition to  $1/8$  and  $1/10$  of its initial concentration are  $t_{1/8}$  and  $t_{1/10}$  respectively. What is the value of  $\frac{[t_{1/8}]}{[t_{1/10}]}$   $\times 10$ ? (take  $\log_{10} 2 = 0.3$ )

**26.** Amongst the following the total number of compounds soluble in sodium bicarbonate is  
2, 4, 6-trinitrophenol, benzoic acid, salicylic acid, acetyl chloride, acetic anhydride, trifluoroethanol, acetamide, benzenesulphonic acid

## Comprehension Type

Transition metal compounds are coloured due to  $d-d$  transition and charge transfer. Colour due to  $d-d$  transition is shown by transition metal compounds

having  $d^1$  to  $d^9$  electrons whereas the compounds containing  $d^0$  and  $d^{10}$  configurations are intensely coloured due to charge transfer transitions.

- 27.** Which of the following compounds is not coloured?

- (a)  $\text{Na}_2[\text{CuCl}_4]$       (b)  $\text{Na}_2[\text{CdCl}_4]$   
 (c)  $\text{K}_4[\text{Fe}(\text{CN})_6]$       (d)  $\text{K}_3[\text{Fe}(\text{CN})_6]$

28. The purple colour of  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$  ion is due to  
(a) unpaired  $d$ -electron  
(b) transfer of an electron  
(c) intermolecular vibrations

## SOLUTIONS OF FEBRUARY 2017 CROSSWORD

## Winners of February 2017 Crossword

- Aditya Sharma, Punjab
  - Garima Gupta, Indore

## **Winners of January 2017 Crossword**

- Aman Diwakar, Agra
  - Devjit Acharjee, West Bengal

## Solution Senders of Chemistry Musing

Set - 43

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  - Abhishek Kumar, Madhya Pradesh

## **Set - 42**

- Mijan Ahamed Khan, West Bengal
  - Chanakya Das, Assam
  - Parmar Prabhatsinh Rupsinh, Gujarat
  - Khandaker Abdul Majid, West Bengal
  - Adithya, Kerala

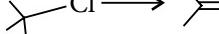
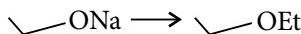
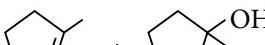
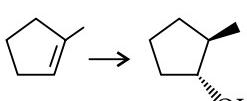
## Matrix Match Type

- 29.** All the compounds listed in column I react with water. Match the result of the respective reactions with the appropriate options listed in column II.

<b>Column I</b>	<b>Column II</b>
(A) $(CH_3)_2SiCl_2$	(P) Hydrogen halide formation
(B) $XeF_4$	(Q) Redox reaction
(C) $Cl_2$	(R) Reacts with glass
(D) $VCl_5$	(S) Polymerisation
	(T) $O_2$ formation

<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
(a) P, Q	P	P, Q, R, T	P, S
(b) P, S	P, Q, R, T	P	P, Q
(c) P, S	P, Q, R, T	P, Q	P
(d) P, S	P, Q	P, Q, R, T	P

- 30.** Match the chemical conversions in column I with the appropriate reagents in column II.

	<b>Column I</b>		<b>Column II</b>
(A)			(P) (i) $\text{Hg}(\text{OAc})_2$ (ii) $\text{NaBH}_4$
(B)			(Q) $\text{NaOEt}$
(C)			(R) $\text{Et}-\text{Br}$
(D)			(S) (i) $\text{BH}_3$ (ii) $\text{H}_2\text{O}_2/\text{NaOH}$
	<b>A</b>	<b>B</b>	<b>C</b>
(a)	P	Q	R
(b)	Q	R	P
(c)	Q	R	S
(d)	S	P	Q
	<b>D</b>		
	S		
	S		
	P		
	R		

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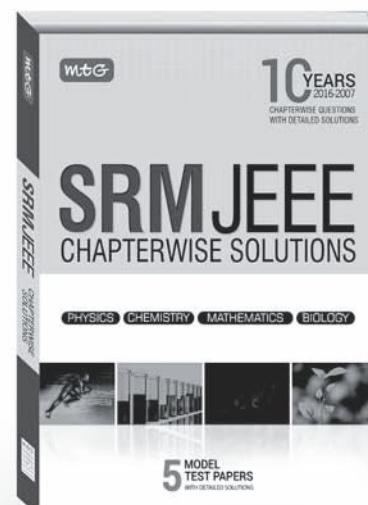
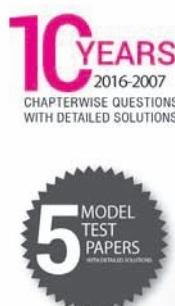
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No. of questions correct .....	<b>74-60%</b>	<b>SATISFACTORY !</b>	You need to score more next time.
Marks scored in percentage .....	<b>&lt; 60%</b>	<b>NOT SATISFACTORY!</b>	Revise thoroughly and strengthen your concepts.



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# CROSS WORD



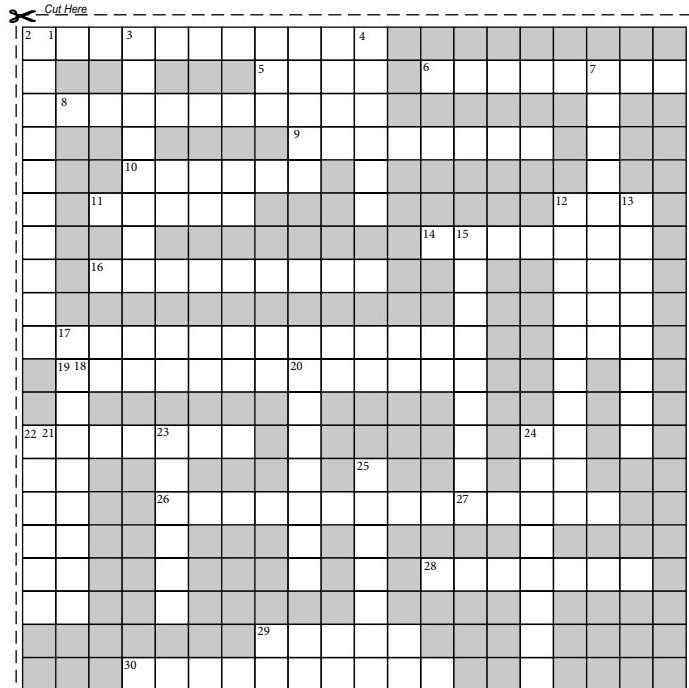
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## ACROSS

- The region in an infrared spectrum below 1500 wave numbers. (11)
- The sum of oxidation numbers of lead in litharge and manganese in permanganate ion. (4)
- The major constituent of the oil from orange peel. (8)
- The trivial name given to  $\alpha$ ,  $\beta$ -unsaturated ketones obtained by condensing an aromatic aldehyde with an aryl methyl ketone in presence of a base. (9)
- A chemical used as a weapon with devastating and horrific effect in the 1914-18 war. (8)
- A molecular structure or state which has the characteristics of two or more other structures. (6)
- A poisonous protein of the lectin class produced from the seeds of the castor bean. (5)
- Chemicals used to break and remove snow or ice. (7)
- He is credited with coining the term, "catalysis". (9)
- Determination of molecular weight of a substance by observing the elevation in boiling point of solution. (12)
- Process of applying a protective zinc coating to prevent rusting. (13)
- An element named for the Greek word for "hidden". (7)
- Colloidal sols containing non-spherical particles which are capable of orientating themselves in a streaming potential. (9)
- Methane is called as \_\_\_\_\_ gas. (5)
- The oxide of this metalloid is toxic and has been used as a vermin poison. (7)
- \_\_\_\_\_ process is an industrial method for preparation of hydrogen by water gas. (5)
- A device which measures the relative density of two liquids. (10)

## DOWN

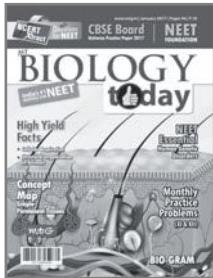
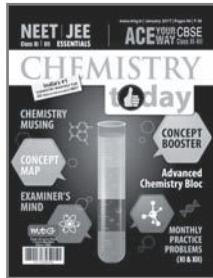
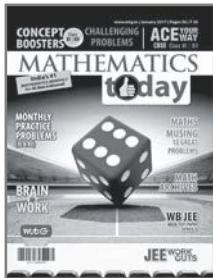
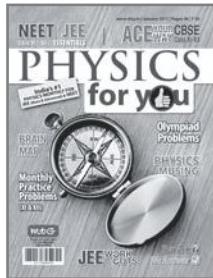
- A method by which hydrophobic particles of an ore are separated from hydrophilic particles in a metallurgical process. (10)
- A non metal, which has layers of hexagonally arranged carbon atoms. (8)
- It is slippery, corrosion resistant plastic. (6)
- A type of isomerism shown by substances which contain several asymmetric centres but differ in the configuration around one asymmetric carbon. (9)



- A high explosive made from a gel of nitroglycerine and nitrocellulose in a base of wood pulp and sodium or potassium nitrate. (9)
- It is estimated that the amount of this element in the earth's crust at any particular time is less than 30 grams. (8)
- Graph of free energy change with temperature is called \_\_\_\_\_ diagram. (9)
- A primary alcohol which is a constituent of geranium oil. (8)
- A mesoionic heterocyclic aromatic chemical compound. (7)
- The nucleus and all inner shell electrons in an atom except the valence electrons. (6)
- The isomorphous salt,  $M_2^I SO_4 M^{II} SO_4 \cdot 6H_2O$  where,  $M^I$  is an alkali metal and  $M^{II}$  is a dipoisitive transition metal. (6)
- \_\_\_\_\_ is a mixture of copper sulphate and slaked lime and used as a fungicide. (8)
- \_\_\_\_\_ process is used for making sulphur (VI) oxide. (7)



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#### PCB combo

<input type="checkbox"/> 1 yr: ₹ 900 (save ₹ 180)	<input type="checkbox"/> 2 yr: ₹ 1,500 (save ₹ 660)	<input type="checkbox"/> 3 yr: ₹ 1,900 (save ₹ 1,340)
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#### Individual magazines

<input type="checkbox"/> Physics	<input type="checkbox"/> Chemistry	<input type="checkbox"/> Mathematics	<input type="checkbox"/> Biology
<input type="checkbox"/> 1 yr: ₹ 330 (save ₹ 30)	<input type="checkbox"/> 2 yr: ₹ 600 (save ₹ 120)	<input type="checkbox"/> 3 yr: ₹ 775 (save ₹ 305)	

Want the magazines by courier; add the courier charges given below:

1 yr: ₹ 240       2 yr: ₹ 450       3 yr: ₹ 600

Tick the appropriate box.

Student  Class XI  XII   
 Teacher  Library  Coaching

Name: \_\_\_\_\_

Complete Postal Address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Pin Code  Mobile #

Other Phone # 0

Email \_\_\_\_\_

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